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Boston Society of Natural History.

FROM

Mrs. Norman S. Easton

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MEMOIRS

OF THE

Royal Society;

Being a New ABRIDGMENT of the

Philosophical Transactions:

Giving an ACCOUNT of the Undertakings, Studies, and Labours of the LEARNED and INGENIOUS in many considerable Parts of the WORLD; from the first Institution of that ILLUSTRIOUS SOCIETY in the Year 1665, to the Year of our LORD 1735 inclusive.

The whole carefully abridg'd from the Originals, and the Order of Time regularly observ'd, with a Translation of the LATIN TRACTS, and the Theoretical Parts apply'd to Practical Uses; also an Explanation of the Terms of ART as they occur in the Course of the Work. Being a Work of general Use to the Publick and worthy the Perusal of all MATHEMATICIANS, ARTIFICERS, TRADESMEN, &c. for their Improvement, in various Branches of Business.

By Mr. BADDAM.

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MEMOIRS

OF THE

ROYAL SOCIETY;

Being a New ABRIDGMENT of the

PHILOSOPHICAL TRANSACTIONS.

An Account of the Death *and* Diſſection *of* John Bayles *of* Northampton; *by Dr.* James Keil. Phil. Tranſ. N° 306. p. 2247.

JOHN *Bayles* the old button-maker of *Northampton*, was commonly reputed to have been 130 years of age when he died; there was no regiſter ſo old, in the pariſh where he was chriſtened; but the oldeſt people, of which ſome were 100, others 90, and others above 80 years, remembered him to have been old, when they were young; their accounts, indeed, differed much from each other; but they all agreed that he was at leaſt 120 years; he himſelf always affirmed, that he was at *Tilbury* camp and told ſeveral particulars about it; and if we allow him to have been then but 12 years old; he muſt have been 130, when he died; he conſtantly uſed to walk to the neighbouring markets with his buttons, till a few years before his death, when he was decrepid and carried abroad; his diet was

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any thing he could get; he never was fonder of one ſort of food than another; he died the fourth of *April* 1706; he lived in three centuries, and in ſeven reigns; his body was exceedingly emaciated, and his fleſh felt hard; the ſhape of all the external muſcles was plainly to be ſeen thro' his ſkin; the *Abdomen* being laid open, the whole *Viſcera* appeared in good order, but paler than ordinary; the *Omentum* was very ſmall; the ſtomach was very much diſtended with wind, and the bottom of it was worn exceeding thin in that part next the ſpleen, being hardly thicker than thin writing paper; in the inner membrane there were no *Plicæ*; the liver was pale, but upon cutting, it was found perfectly ſound; the gall bladder was of a larger ſize than ordinary; the ſpleen was not ſo big as one of his kidneys, both which were firm and ſound, as were all the urinary paſſages; in the right kidney there were a few ſmall yellow grains of gravel; the inteſtines were all ſound, the meſentery was covered with fat; the cartilages of the *Sternum* were not harder than uſually they are; the ribs were brittle, for leaning gently upon one of them it broke; the lungs adhered to the *Pleura*, they were ſpongy, whitiſh, and had ſeveral black ſpots of blood; the cavity of the *Thorax* was large and clear; the heart was large, thick and fat; and tho' he had been always a little man, yet the diameter of the *Aorta*, before the carotids go off, was above two inches, which is conſiderably bigger than ever the Dr. obſerved; the *Aorta* in the *Abdomen* and *Iliacs*, was for the moſt part cartilaginous; the bones of the ſcull were ſound and good; there was a ſmall oſſification on the inſide of the *Dura Mater*, near the *Falx*; the brain was firmer and more ſolid than uſual, and in cutting, it hardly moiſtened the ſides of the knife; the ventricles were full of *Serum*; he had loſt the uſe of his eyes for ſome years; but his hearing was good till he died; his *Teſtes* and *Penis* were of a large ſize: There is no doubt, but that the weakneſs of his ſtomach, and the hardneſs of the *Aorta*, were the cauſes of his death; the coats of the ſtomach were ſo thin, that they had not ſtrength enough to keep out the air, and conſequently, his digeſtion muſt have been ſpoiled; he had not eat meat for ſome years, and latterly he lived only on ſmall beer, bread and butter, and ſugars; and it was impoſſible that his blood could circulate duly, whilſt the great artery, having loſt its elaſticity, by becoming cartilaginous, could give no motion thereto; it is very probable that this was the cauſe of his irregular and intermitting pulſe, which Dr. *Keil* had felt ſome years before he died; it is obſervable, that the greateſt part of his blood (which was in a larger

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a larger quantity than the Dr. expected) was contained in the arteries; whereas, generally in all dead bodies the veins are full, and the arteries almoſt empty; for the arteries being diſtended by the blood, which they receive upon the laſt *Syſtole* of the heart, contract again by their natural elaſticity, and empty themſelves into the veins, from whence it returns no more; but in *Bayles*, the great artery having loſt the power of contracting itſelf, it retained the blood it received by the laſt *Syſtole* of the heart.

This account agrees with that given of old *Parre* by the famous Dr. *Harvey* in moſt particulars, excepting in the cauſes of their deaths; but in both nothing ſeems more remarkably the effects of old age, than the ſmallneſs of their ſpleens, which undoubtedly was owing to the contraction of the fibres of that lax and ſpongious inteſtine; the whiteneſs of the *Viſcera* in both muſt be likewiſe owing, either to the ſame contraction or cloſeneſs of the coats of the blood-veſſels, or to a want of blood; Dr. *Harvey* ſays nothing of the quantity of blood he found in old *Parre*; but if we may conjecture from his body being fleſhy, from the goodneſs of his ſtomach and appetite, and from the diſeaſe he died of, there could be no want of blood in him; in old *Bayles* there ſeemed to be more blood, than in ſeveral others Dr. *Keil* had ſeen, whoſe *Viſcera* appeared redder; and it can hardly be conceived, that the *Aorta* could be ſo large, without a large quantity of blood, unleſs there had been ſome ſtricture upon ſome other parts of it, which the Dr. did not perceive; and therefore it ſeems not improbable, that this whiteneſs of the *Viſcera* was owing to the cloſeneſs of the blood-veſſels in both; and it is no ſmall confirmation of this opinion, that the fleſh and ſkin felt hard, and the brain firm and ſolid; and it is likewiſe highly probable, that the ſame diſpoſition, might give a cloſeneſs or hardneſs to the veſſels every where elſe; it is true, that this was a diſtemper; but then it is as true, that it was a diſeaſe of old age, and may juſtly be reckoned one of the effects thereof; and for a further proof of what the Dr. has ſaid, he obſerved, that in preparing a piece of the ſmall gut for an injection, the *Tunica villoſa* felt more like a fine file, than the ſofteſt velvet, and that he could uſe more violence in injecting the veſſels, than theſe parts will uſually bear: Whoever conſiders, how ſoft a ſubſtance an animal body is at firſt, and how from time to time it acquires a firmneſs and ſolidity, will be eaſily induced to believe, that old age brings a more than ordinary hardneſs on all the fibres and veſſels; the neceſſary conſequence of this hardneſs,

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and contraction of the fibres and veſſels of old people, is a diminution of their ſecretions, which, *cæteris paribus*, are always proportional to the orifices of the glands; hence it is, that we find the ſkin of old people always dry, their perſpiration being but very little; they are alſo generally coſtive; for old *Bayles* for ſome years went to ſtool, but once in 10 or 12 days; and old people are always complaining of a want of moiſture; not that the radical moiſture is dried up, but becauſe the natural ſecretions, by reaſon of the contraction of the glands, are diminiſhed; the Dr. has already obſerved, that there was found more blood in this old man, than could have been expected in ſuch an emaciated body; and without doubt, it would have been larger, had his ſtomach and appetite been as good as old *Parre*'s; the fullneſs of the veſſels, and the frequent rheums and catarrhs of old people, evince this neceſſary conſequence of the cloſeneſs of the coats of the veſſels; all which agrees with what the writers of inſtitutions ſay, that old men are *ratione partium ſolidarum frigidi & ſicci*; *ratione excrementorum frigidi & humidi*; from this retention of the excrementitious parts of the blood, we may expect all the bad conſequences of a vitiated *Plethora*, and languid motion of the blood; for the fibres of the arteries being now become hard, inſtead of aſſiſting, obſtruct the heart in circulating the blood; and the quantity of animal ſpirits ſeparated in the glands of the brain, muſt likewiſe be diminiſhed, not only becauſe of the retention of the excrementitious humours, but alſo becauſe of the cloſeneſs and firmneſs of the brain itſelf; ſo that the contractions of the heart and all the muſcles muſt be weak, and conſequently, the motion of the blood languid.

Gelidus, tardante Senectâ,
Sangues hebet.

A due conformation of all the vital parts is moſt certainly neceſſary to bring a man to a full old age; but above all the reſt, there are two cauſes, which to Dr. *Keil* ſeem to have had the greateſt ſhare in procuring a longævity to old *Parre* and *Bayles*, by retarding the bad effects juſt now mentioned; the firſt is the heart, which in both was ſtrong and fibrous; for that being left alone to labour the circulation of a large quantity of languid blood, a great force is abſolutely requiſite to propel it thro' unactive veſſels, to the extreme parts of the body, and back again; no doubt, this is more eaſily done in men of a low ſtature, as old *Bayles* was, which Dr. *Keil* is apt to think as a qualification of old

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old age; the ſecond, was the largeneſs of their cheſts, and the goodneſs of their lungs, by which the air had its full effort upon every particle of the blood, in rendering it florid, and attenuating it in ſuch a manner, as that it might eaſily move thro' the contracted channels of an old body: Few have the happineſs of ſuch a heart and lungs, yet moſt men wiſh to live long; nor was it an eaſy matter for phyſicians to give rules for preventing the bad conſequences of extreme old age, whilſt the effects of a long circulation of the blood were unknown; of which we can only be certain by diſſections of old perſons, and theſe are not numerous enough to ground any thing certain upon; but, if after-obſervations ſhall confirm the remarks, that have been now made, no doubt the indication will be, to preſerve ſuch a ſoftneſs in all the fibres, that they may eaſily yield to the preſſure of the blood, and by their elaſticity reſtore themſelves to their former ſtate, giving thereby a new *Impetus* to the blood.

An Experiment, *ſhewing the production of a conſiderable light upon a ſlight attrition of the* Hands *on an exhauſted* Glaſs Globe, *&c. by Mr.* Hauksbee. Phil. Tranſ. N° 307. p. 2277.

MR. *Hauksbee* took a glaſs-globe about nine inches diameter, and having exhauſted it of air, he took it off the pump; but firſt there was a cock turned, which prevented the re-admiſſion of the air; the globe being thus ſecured and fixed, and put into a ſwift motion by turning the large wheel, deſcribed in *Phil. Tranſ.* N° 304; Mr. *Hauksbee* applied his open and bare hands to its ſurface, which in a very little time produced a conſiderable light; and ſtill as he moved his hands from one place to another, that the humid effluvia, which very readily condenſe on glaſs, might be diſcharged off every part of it, ſo the light improved, till words in capital letters were legible by it; at another time, when he made this experiment, the light produced was ſo great, that a large character could, without much difficulty be read by it; and at the ſame time, tho' in a pretty large room, the whole became ſenſibly illuminated; ſo that the farthermoſt wall, which was diſtant at leaſt 10 foot, was viſible; the light appeared of a curious purple colour, and was produced by a very ſlight and tender touch of the hands, the globe at the ſame time hardly being ſenſibly warm; and Mr. *Hauksbee* did not find, that the light was improved any thing by a more violent attrition; nor is the higheſt degree of the rarefaction of the air in the globe, abſolutely neceſſary to the production of this light; for,

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for, it ſeemed to continue with a very little diminution of its colour or vigour, till he believes, more than a fourth part of its air was re-admitted; Mr. *Hauksbee* often obſerved the ſame, in the light produced in the mercurial experiments, only that its colour in theſe was always pale; and there being ſuch a ſeeming congruity of appearances in all the circumſtances, with thoſe made on the attrition of glaſs; one might with ſome probability, conclude, that the light produced proceeds from a quality in the glaſs, upon ſuch a friction or motion given it, and not from the mercury, any other way than as a proper body, which falling or rubbing on the glaſs, produces the light; and what would ſeem farther to corroborate ſuch a concluſion is, that Mr. *Hauksbee* took a mercurial barometer, and rubbing the upper or deſerted part of the tube between his fingers, a light enſued, without the motion of the quickſilver; yet, for all this, the concluſion is ſtill doubtful, and there may be ſuch a quality as light in mercury, as well as in glaſs, or any other body, as ſeemed probable from the following experiment made on purpoſe; Mr. *Hauksbee* took a ſmall quantity of quickſilver, and putting it into a galley-pot, wherein varniſh had been often uſed, by which means it had got a pretty thick lining of it; the weather at that time was moiſt (the humidity of the air ſometimes rendering the experiment unſucceſsful even in glaſs, or at leaſt very much impairing the appearance) which had an influence upon the varniſh, to ſoften it ſomewhat; however, the ſucceſs of the experiment was, that when the galley-pot with its contained mercury came to be *in Vacuo*, upon ſhaking the pump a light appeared, and that without the concurrence of glaſs, or a more proper ſeaſon to aſſiſt it; moreover, the medicine call'd *Mercurius dulcis*, when broken in the dark, yields remarkable flaſhes of light, which, perhaps, may be owing to the ſalts, with which each little globule of the medicine is envolop'd; ſince Mr. *Hauksbee* has often obſerved, that loaf-ſugar, when ſtruck or broken in the dark, affords a light; and Mr. *Hauksbee* cannot tell, but that ſalts as cloſely united in their parts, as the above-mentioned ſugar, may give a light upon a violent ſeparation of them, till he has made ſome trials; 1. Whether the medicine when broken *in Vacuo*, will afford any light, which he thinks he may expect, if it proceeds from the mercury, ſince if there is any ſuch quality in that body, it ſeems to be the moſt proper medium to diſcover it in; and 2. What the ſalts will do without mercury, both in the open air and *in Vacuo*; for there are ſome bodies that appear luminous in the open air, which altogether

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loſe that ſhining quality in *in Vacuo*; as for inſtance, he took a piece of wood, which he ſuppoſed might have lain under ground a conſiderable time, it was very moiſt, but not rotten, and appeared very vividly of the colour of fire in the dark; having included it under a receiver on his pump, he found that as the air was exhauſted, ſo did its fire-like appearance decay, till at laſt *in Vacuo* it became perfectly void of light; and as the air was re-admitted, ſo by degrees it recovered its priſtine appearance; this he repeated ſeveral times with the like ſucceſs: To return, after the attrition of the exhauſted globe was continued for ſome time, the above-mentioned cock was returned, which gave liberty to the air to inſinuate itſelf into the globe, thro' the joints of the ſcrews, the motion of the large wheel, and the application of the hands continuing all the while; and as the air filled the globe, ſo the appearance of the light continued to alter, till the like quantity of air had re-entered, as was exhauſted from it; then there appeared as great a difference of light from what was produced, when evacuated of air, as when the Experiment was made with mercury *in Vacuo* and in the open air; certain ſpecks of light were then to be ſeen upon the fingers that touched the globe; but without any great luſtre; and it was very remarkable that whilſt Mr. *Hauksbee*'s hand continued upon the glaſs in motion, if any perſon brought his fingers, within an inch or thereabouts, towards any part of the glaſs in the ſame horizontal plane with his hand, a light would appear on the fingers, tho' they did not touch the glaſs, and Mr. *Hauksbee*'s neck-cloth at the ſame time, being an inch or two diſtant from it, appeared of the colour of fire, without any communication of light from the globe; the former part of both trials was alike, ſaving only, that upon application of white ſheep's leather in the latter, a very good light was produced, whilſt the wool ſide was held next to the globe; but, when the other ſide of the ſame piece of leather was turned to the globe, there enſued no light, tho' it was held to it for ſome time; but as ſoon as it was changed again, the light appeared as at firſt, and ſo upon ſeveral repetitions it was always the ſame; as to the latter part of this trial, the air was not admitted all at once as before, but at ſeveral times, whereby the modes of light produced in the different mediums, were more obſervable, tho' no very great alteration happened, either to its colour or vigour, 'till more than one fourth of the globe's natural contents of air was admitted; but, ſometimes before half the air was permitted to re-enter, it was an agreeable ſight to behold, how the light began to break out in rays from that ſide where the globe was touched, fil-

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ling its whole body with very odd figures; and the ſaid rays of light, upon the admiſſion of more air, became more ſlender, ſtriking a light againſt the oppoſite ſide of the glaſs, and thence reverberating again in a very agreeable manner; but when more and more air was admitted, the light and figures were diminiſhed, till the appeaance became the ſame as in the firſt trial.

Obſervations *on a* Courſe *of* Anatomy, *of* Marchetti's, *at* Padua; *by Mr.* Ray. Phil. Tranſ. N° 307. p. 2283. *Tranſlated from the* Latin.

S. *Marchetti* began his diſſection in the uſual manner; *viz.* by making a crucial inciſion on the *Abdomen*, yet without touching the *Umbilicus*; he ſeparated the *Cuticula* from the *Cutis*, by holding a lighted candle under the latter, by which means the *Cuticula* was raiſed into a bliſter, and then he eaſily ſeparated it with his knife; for it cannot be ſeparated from the *Cutis*, but either by an actual or potential cautery, or what cauſes bliſters; under the *Cutis* a great deal of fat, half an inch thick, inveſted the whole *Abdomen*; and this fat was furniſhed with innumerable fibrils, which ſerve to ſupport it; under the fat lay the *Panniculus* or *Membrana carnoſa*, which yet did not appear fleſhy in this place, and under the ſaid membrane there was ſome little fat. S. *Marchetti* affirmed, that this membrane in brutes, is double, becauſe they can move and corrugate their whole ſkin; it is alſo double in a man's forehead, whence he can contract and knit his brow, and in ſome it is double in the *Occiput*, by which means they can move all the hair of their heads; Mr. *Ray* obſerves, that others aſſign a different cauſe for theſe motions; *viz.* that the *Membrana carnoſa* in the forehead and *Occiput* cloſely adheres to the *Cutis*, and degenerates into a muſcle, which is the more probable opinion: *Marchetti* came next to the muſcles of the *Abdomen*, and firſt of all to the oblique deſcending muſcles, which ariſing about the middle of the ſpurious ribs, are indented as in the ſutures of bones, with the *Serratus major anticus*; on its poſterior part lay the *latiſſimus Dorſi*, which therefore, muſt previouſly be raiſed a little; the *Muſculi recti* are connected by a broad tendon to the proceſſes of the *Oſſa pubis*, and in their ſuperior part they ariſe on both ſides by nervous tendons from the cartilage of the firſt ſpurious rib, near the *Cartilago enſiformis*; the oblique aſcending muſcles ariſing by radiated fibres from the ſuperior edge of the *Os Ilium*, receives the *Vena Muſcula* from the iliac branches; the double tendon of the aſcending muſcles ſheaths the *Muſculi recti*; for one part of it lies upon the *Muſculus rectus*, which before

before it has reached half the breadth of the muſcle, is firmly connected with the tendon of the oblique deſcending muſcle, or rather coaleſces in ſuch a manner, as not to be ſeparated therefrom; the other part lies under the *Muſculus rectus*, and coaleſces in the ſame manner with the tendon of the tranſverſe muſcles; it receives a vein from that called the *Muſcula*, which ariſes from the *Iliac* branch; the *Muſculi recti* had only two nervous lines or inſcriptions; tho' as *Veſlingius* obſerves, ſome have three, others four or five; in theſe muſcles were to be ſeen the *Anaſtomoſes* of the internal mammary and epigaſtric veins; the tranſverſe muſcles ariſe from the proceſſes of the *Vertebræ* of the loins; but the *Muſculi obliqué aſcendentes*, are not connected to theſe *Vertebræ*, as *Marchetti* obſerved; in this ſubject were alſo obſerved the *Muſculi pyramidales*, which lie obliquely upon the *recti*. Obſervat. 1. The fat on the back of women is ſofter than that in men. 2. The ſkin about the *Ilia* is corrugated in ſuch as have had children, but not ſo in virgins. 3. A vein, an artery and a nerve do always accompany each other; the artery being on the right, the vein in the middle, and the nerve on the left hand. 4. There was obſerved under the muſcles upon the *Peritonæum* near the loins, a large quantity of fat, by which means the muſcles in this part are eaſily ſeparated from the *Peritonæum*; but near the *Linea alba* it adheres ſo cloſely to the tendons of the muſcles, as not to be ſeparated by any means. 5. *Marchetti* affirmed, that the muſcles had tendons at their originations. 6. He began the diſſection of the muſcles from their riſe, or head, becauſe thus, the motion or uſe of a muſcle is more eaſily diſcerned. 7. Surgeons ſhould take care not to cut the muſcles tranſverſely, leaſt they cauſe convulſions by cutting thro' the nerves, which always run with parallel fibres. 8. In order to a right diſſection and ſeparation of the muſcles, a perſon ſhould accurately obſerve, and follow the direction of the fibres. 9. The tranſverſe muſcles, both at their riſe and termination, have a broad membranous tendon: After this S. *Marchetti* ſhewed the five lumbar *Vertebræ*, each of which has ſeven proceſſes, one ſpinal, two tranſverſe, two aſcending obliquely, and two deſcending obliquely; the oblique aſcending proceſſes of the inferior *Vertebra* are articulated by *Ginglymus* with the oblique deſcending proceſſes of the ſuperior *Vertebra*; but the *Vertebræ* themſelves by *Harmonia*, the cavity of the ſuperior *Vertebra* receiving the protuberance of the inferior; the *Os ſacrum* ſometimes conſiſts of ſix bones, and commonly of five; when of ſix, the *Os Coccygis* has only three bones, and when of five, it has four; the *Os*

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Coccygis is incurvated internally for the greater conveniency of ſitting; the ſurgeon by putting his finger into the *Inteſtinum rectum*, and retracting or bending back the *Os Coccygis*, may in hard labour facilitate the birth, and this *Marchetti* affirmed he had done; the *Os ſacrum* has large *Foramina* for the egreſs of the nerves; he affirmed that the bones which conſtitute the *Pelvis* are no larger in women than in men, in proportion to their bodies as others affirm; the *Os Ilium*, *Os Pubis*, and *Iſchium* in adults coaleſce, as it were, into one bone; but are diſtinct in infants, and connected together by a cartilage; all theſe three bones unite in the *Acetabulum Femoris*, and each of them forms a part of its cavity; in the *Ilium*, *Marchetti* diſtinguiſhed its *Spine*, *Coſta Dorſum*, and two *Sinus*'s, one is the ſuperior, over which a nerve proceeding from the higheſt *Foranen* of the *Os ſacrum* deſcends towards the legs, the other the inferior, between two eminencies, deſigned for the conveniency of ſitting; the nerves go out at the ſides of the *Vertebræ* thro' *Foramina*, formed between two *Vertebræ*: In the next place, *Marchetti* ſhewed the *Viſcera* and *Inteſtines* in their natural ſituation; *viz.* the *Rectum*, and the *Colon*, which ſurrounded all the inteſtines; the *Cæcum* on the right ſide was no bigger than a little finger, which *Marchetti* from his own obſervation affirmed was no larger in a *Fœtus* and an infant, and that he never found it replete with *Fœces*; immediately above the *Cæcum* begins the *Ilium*, which is larger, and replete with *Fœces*; next the *Jejunum*, which is more fleſhy, furniſhed with more veſſels, is redder, and without any *Fœces*; the *Duodenum* terminates at the flexure; that part of the meſentery, to which the *Colon* is connected, is called the *Meſocolon*, and the other part, to which the thin guts are connected, is by way of eminence, called the meſentery; the inferior meſenteric artery ſends out branches to the *Colon*, and *Rectum*, from whence proceeds the hemorrhoidal artery; and the ſuperior meſenteric artery furniſhes almoſt all the reſt of the inteſtines; the ſpleen in this ſubject was larger than it is in a natural ſtate, which he aſcribed to this perſon, being given to exceſſive drinking; the *Colon* in this ſubject adhered to the *Peritonæum*; the pyramidal muſcles, ariſing on both ſides from the proceſſes of the *Os pubis*, and aſcending obliquely with their neighbouring tendons, terminated in the *Linea alba*; according to *Fallopius* theſe ſerve, by compreſſing the bladder, to diſcharge the urine; where theſe are wanting (as ſometimes is the caſe) the extremities of the *Muſculi recti* are broader; he then ſhewed the umbilical vein, which is inſerted into the fiſſure of the liver, and degene-

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rates into a ligament; next the umbilical arteries, which being connected with the *Peritonæum* run as far as the *Iliac* branches of the *Aorta*; then the *Urachus*, which being alſo connected with the *Peritonæum*, deſcends to the bottom of the *Veſica*, and ſupports it; in men it ſerves for a ligament, nor is it at all perforated; he afterwards ſhewed the *Tubæ* of the *Uterus*, its *Ligamenta, rotunda* the *Teſtes Muliebres*, the ſpermatic veſſels, and likewiſe the *Ligamenta lata*; then the *Ligamentum latum* of the liver; that the liver in perſons alive and in health, does not lie upon the ſtomach, and that therefore unguents, fomentations and other external applications to the region of the ſtomach are very proper; the *Ligamenta rotunda Uteri* perforate the *Peritonæum*, and all the muſcles; and afterwards they divide and ſend a branch to the *Clitoris*, and another to the knee; he next accurately diſſected the gaſtric and gaſtro-epiploic veins and arteries, wherein he entirely agrees with *Veſtingius*. *Obſ.* 1. That chaſte women may ſometimes have *Bubo*'s, but theſe may be diſcuſſed without ſuppuration; whereas venereal *Bubo*'s, unleſs a *Gonorrhœa* enſues, conſtantly ſuppurate. 2. At the beginning of the *Colon* a valve was obſerved, from an inflammation of which, *Marchetti* from his own obſervation affirmed, the *Iliac* paſſion, called *Volvulus*, or the twiſting of the guts ariſes, which hinders the deſcent of the *Fœces*; for he had ſeen the *Foramen* ſo ſtreightened, that the point of a ſmall pin could hardly enter it: The veins of the ſtomach are either proper or common; the proper are 1. The *Gaſtricæ ſiniſtræ minores*; three or four of them (the firſt and ſhorteſt of which is called the *Vas breve*) ariſe near the ſpleen from the ſplenic branch of the *Vena porta*. 2. The *Gaſtrica ſiniſtra major* or *coronaria*, becauſe ſpread like a crown on the top of the ſtomach. 3. The *Gaſtrica dextra* or *Pylorica*: The common veins are 1. The *Gaſtro-epiploica ſiniſtra*, which ariſing near the ſpleen from the ſplenic branch creeps along the bottom of the ſtomach; from hence, it ſends out branches to the ſtomach and often to the *Omentum*, particularly, a remarkable one, called the *epiploica ſiniſtra*. 2. The *Gaſtro-epiploica dextra* in this ſubject aroſe near the *Pylorus* from the meſenteric branch, and likewiſe creeped along the bottom of the ſtomach, ſending branches from thence to the ſtomach, and then to the *Omentum*, and its greateſt branch or trunk was inſerted by *Anaſtomoſis* into the *Gaſtro-epiploica dextra*; this is a remarkable vein, ſending out as remarkable a branch, called the *Vena epiploica dextra*: In the bottom of the gall-bladder were obſerved no veſſels to convey the bile thither, but ſome poroſites which

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which transmit it; and therefore when the *Vesicula* is separated from the liver, a bilious humour is plainly seen to ouse from it; and some small capillary veins from the *Parenchyma* of the liver are spread in such a manner thro' the membranes of the *Vesicula*, that it cannot be separated from the liver without effusion of blood: *Marchetti* affirmed, that the gall-bladder, where joined to the liver, consisted only of a single membrane, but every where else of a double one: The *Meatus cysticus*, where it terminates in the common duct, had no valve, but an *Ostiolum*, or mouth to hinder the reflux of the bile: The liver has three *Sinus*'s; one wherein the *Cystis fellea* lies; the second into which theumbilical vein enters, and the third, where the trunk of the *Vena cava* passes; the *Cystis fellea* had a very large artery, but small veins; *Marchetti* affirm'd, that he had observed, where the artery was large, there the vein corresponding thereto was small, and *vice versâ*; but Mr. *Ray* questions this; *Marchetti* moreover affirmed; 1. That an obstruction of the *Meatus cysticus* causes the yellow jaundice, and of the *Porus choledochus*, the black jaundice. 2. That the vessels of the *Vena porta* and *Cava* are not conjoined in the liver by inosculation, but by an *Harmonia*, or mutual incumbency of the vessels on each other. 3. That the *Vena porta* does not assume a new membrane within the *Parenchyma* of the liver. 4. That he observed the lacteals inserted into the very trunk of the *Vena porta*. 5. That he could never find, nor believe, that there was any common receptale of the chyle; but Mr. *Ray*'s experience convinced him of the contrary. 6. That he saw a remarkable branch of the *Ductus chylifeerus* terminate in the *Pancreas*. 7. That he supposed the use of the spleen was to separate the black bile from the blood, and convey it together with the blood thro' the splenic branch to the liver, where it is discharged thro' the *Ductus choledochus* into the intestines. 8. That he supposed the lacteals drained the chyle from the intestines, and convey'd it to the *Pancreas*, whose use is to elaborate it farther, and discharge the excrementitious parts into the intestines by the *Ductus Virsungianus*. 9. That he had observed the lacteals spread in the *Mesocolon* as far as the intestines; and this Mr. *Ray* confirms. 10. That the external hæmorhoidal veins do not arise from the *Vena cava* but are branches of the *Vena porta*; and that its extreme ramifications perforate the skin, and terminate in protuberances under the *Cuticula*, and to these, leeches are applied; the hæmorrhoidal vein sometimes arises from the splenic branch, at other times from the mesenteric, and very often at the very divarication

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cation of the *Vena porta*; this vein ſpreads its branches thro' the whole *Meſocolon*; the *Meſocolon* differs from the meſentery in thinneſs; three or four branches of a pretty large artery, ariſing from the cæliac, enter the ſpleen; a great many branches of the ſplenic vein are diffuſed quite thro' the *Parenchyma* of the ſpleen, contrary to the opinion of *Sylvius*, who affirms, that their orifices only open into the ſpleen, but do not penetrate its ſubſtance: *Obſ.* when any perſon dies of a lingering illneſs, the ſpleen grows black; but if of a violent death, it becomes redder than ordinary; the *Ductus Virſungianus* and the *Porus choledochus* perforate the *Duodenum* in the ſame place; and ſometimes they enter that inteſtine by different mouths, as in dogs: *Marchetti* ſhewed the *Plexus meſentericus*; the *Porus choledochus* in this ſubject appeared to be very large; the left kidney here and in all other ſubjects is larger than the right, and ſituated higher and more remote from the trunk of the *Vena cava*, and conſequently its emulgent vein is longer; for which *Marchetti* gave a very probable reaſon; *viz.* That the liver lying upon the right kidney, both depreſſes it and hinders its growth; this ſubject had two emulgent arteries on the right ſide, the one entering into the *Sinus* of the kidney in the uſual place, and the other into its ſuperior extremity; the *Ureters* in this woman were very large, and according to *Marchetti* are ſo in all women, as they are of a moiſter temperament than men, and have a greater diſcharge by urine; the right *Glandula renalis* receives a vein from the trunk of the *Cava*; but the left from the emulgent; the *Glandulæ renales* had internally a cavity, and the right *Glandula renales* lay upon the kidney; both the ſpermatic arteries ariſe near each other from the trunk of the *Aorta* below the emulgents; one of the veins ariſes from the emulgent, and the other, *viz.* the right ariſes with a double trunk, one from the emulgent, and the other from the trunk of the *Cava*, which a little after unite; *Marchetti* affirm'd he had ſeen the lacteals in pregnant women ſpread as far as the *Uterus*, which he probably conjectures may convey to the *Uterus* that watry *Serum*, in which the *Fœtus* ſwims; Mr. *Ray* very readily found theſe lacteals in a pregnant ſheep; the meſentery ariſes from the three ſuperior *Vertebræ* of the loins; he ſhewed the ſeminal veſſels, which deſcend to the *Teſtes*, but do not enter their ſubſtance, but running over the *Ligamenta lata*, to the convex ſide of the teſticle, are partly ſpread on the *Tubæ* of the *Uterus*, and partly on, the *Uterus* itſelf; the *Tubæ Uteri*, ſituate at each angle of the bottom of the *Uterus*, anſwer to the *Cornua Uteri* in brutes, and are entirely hollow; ſo as to admit a probe from

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the *Uterus* to their extremities; their internal coat is whitiſh, and in them is often found a white ſerous humour, which is ſuppoſed to be the *Semen Muliebre*; the *Teſtes Muliebris* have no *Epididymides*; at one extremity they are connected with the *Uterus* by nervous or tendinous ligaments; their ſubſtance is ſofter and laxer than that of the *Teſtes* in men; one of theſe in this ſubject, that was ulcerated, had a cavity; *Marchetti* ſhewed by a remarkable experiment, that neither the *Teſtes* in men, nor thoſe in women contribute any thing to generation, for he cut off the *Teſtes* of a dog, leaving the *Epididymides* entire; then he ſhut up a bitch in a chamber for three years, and when ſhe was proud, he let no dog come near her, but this caſtrated one, who often lined her; and in theſe there years ſhe littered thrice, at one litter ſhe had ſeven puppies, at another nine, and at a third five; he likewiſe gave an account of a caſtrated horſe, that had one *Epididymis* left entire, who notwithſtanding had often impregnated mares, and was much inclined to venery; he affirmed the like of a dog that his own ſervant had caſtrated; and at laſt, he gave an account of a certain countryman, that had loſt both his *Teſtes* by venereal *Bubo*'s having only one *Epididymis* left, who notwithſtanding married, and had three ſons; therefore, *Marchetti* ſuppoſes, that the *Teſtes* ſerve for no other uſe, than what *Ariſtotle* aſſigns them, *viz. That they are weights to hinder the ſpermatic veſſels from being folded up*; and indeed, the ſeminal veſſels do not terminate in, nor paſs thro' the ſubſtance of the *Teſtes*, but only the *Epididymides*; the cavity of the *Uterus* is very narrow and ſmall, but its coat is thicker than one would be apt to ſuppoſe; the *Ligamenta rotunda* of the *Uterus* are not perforated into it, but they in ſome meaſure anſwer to the *Vaſa deferentia* in men; the internal orifice of the *Uterus* in pregnant women is ſealed up with a viſcid and glutinous matter, as Mr. *Ray* had often obſerved in a cow, ſo that nothing can penetrate into the *Uterus*, nor any ſeed be injected into it, and conſequently there can be no ſuch thing as ſuperfœtation; yet, *Marchetti* affirmed, he had heard of a certain countrywoman, who three months after ſhe had had one child, was delivered of another; the orifice of the *Uterus* is like the mouth of a tench, and its body like a cupping-glaſs; the *Vagina Uteri* is large and its inſide full of *Rugæ* which are quite obliterated and become ſmooth in common proſtitutes; ſeveral veins and arteries tend to the *Vagina*, ariſing internally from the iliac or hypogaſtric branches, and joining again in *Anaſtomaſes* and ſurpriſing *Plexus*'s, are ſpread on its ſuperficies; and it is probable that their orifices or capillary extremities open into its cavity

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cavity and discharge into it the menstruous blood; tho' *Marchetti* affirmed, he could never discover the orifices of these vessels; which is no ways surprising: Some of these branches are also spread on the neck of the *Uterus*; *Marchetti* further shewed the *Labia pudendi*, the *Clitoris* in the superior angle of the *Rima*, as also the *Alæ* or *Nymphæ*, the *Urethra* or *Meatus urinarius*, and the membranous circle which divides the *Pudendum* from the *Vagina Uteri*, and which in virgins is entirely possessed by a membrane called *Hymen*, excepting the *Foramen* in the middle, thro' which the *Menses* flow; this circle is also seen in women deflowered, contracting the *Pudendum* in that place, and beyond it the *Vagina* is laxer and larger; the *Vagina* in this subject ran downwards beyond the internal orifice of the *Uterus*, and should the *Penis* happen to be longer than ordinary it would inject the *Semen* beyond the internal orifice of the *Uterus* into this *Sinus*, and so this woman could not be impregnated: *Marchetti* likewise affirmed, he had observed in pregnant women, that the *Uterus* was almost two fingers thick. *Obs.* 1. The reason why virgins are by copulation freed from the green-sickness, is, because the *Penis* does somewhat distend the *Vagina*, and by friction open the orifices of the veins, and so cause the *Menses* to flow. 2. The proper place to make an incision in women afflicted with the stone, is the superior part of the *Vulva* near the *Labia*, by introducing a probe into the *Urethra*, and making the incision upon it in the fleshy neck of the *Vesica*. 3. According to *Marchetti*, the *Urachus* in a man (nay, in a *Fœtus in Utero*) is imperforated, and only serves as a ligament to sustain the *Vesica*. 4. That he never found a stone sticking in the middle of the *Ureter*, but always, either near the *Pelvis*, or the bladder.

Marchetti shewed the muscles of the breast, and first the pectoral muscles, which serve to draw the arm to the breast; for their insertion consult *Vesslingius*; next he shewed the *serrati antici minores*, which serve to move the *humerus* forwards, and being situated under the pectoral muscles are inserted into the *processus coracoides*; then he raised the *serrati antici majores*, that serve to draw the *Scapula* downwards and forwards, and are inserted into the basis of the *Scapula*; afterwards the external intercostals, which arising from the inferior side of the superior rib are inserted into the superior edge of the inferior rib, and then the internal intercostals, which arise from the superior edge of the inferior rib, and terminate in the inferior margin of the superior rib; the fibres of these muscles intersect each other obliquely in the manner of a St. *Andrew*'s cross; the fibres of any of these muscles are not perpendicular, but oblique to the *Costæ*; he took notice of the mammary veins and arteries, the

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external arising from the axillary, and the internal from the subclavian; and as they advance some way within the cavity of the *Thorax*, they are divided into two branches, one of which perforates the muscles of the *Thorax*, and is distributed thro' the *Mammæ*, the other descending to the middle of the *Musculus rectus*, is joined by *Anastomosis* to the epigastric vein: *Marchetti* affirmed he had observed, that each capillary ramification of this vein terminated in each lacteal tube of the *Mammæ*, and therefore he supposed that the milk was not generated from the chyle, but from the blood; the subclavian muscles arising from the clavicles, where they join the *Acromion*, are inserted into the cartilage of the first rib; we observed the *Sphincter*, and the muscles called *Levatores ani*, all which arise from the inferior side of the *Os sacrum*, where it joins the *Coccyx*: In ulcers and *Fistula*'s *in Ano*, Surgeons should take care not to cut transversely the fibres of the *Sphincter*, because, by that means the patient may lose the retentive faculty; the cephalic vein divides the pectoral and deltoid muscles; in the neck we first of all observed the fleshy *Platysma Myodes*, for the *panniculus carnosus* in this place degenerates into a muscle, and being fastened to the chin draws the head downwards; next the mastoidal muscles; then the digastric muscles, which with their tendon perforate the *Stylo-cerato-hyoid* muscles; he shewed the muscles of the *Os Hyoides*, of which there are six pair. 1. The *Sterno-hyoides*. 2. The *Coraco-hyoides*. 3. The *Stylo-cerato-hyoides*. 4. The *Thyreo-hyoides*. 5 and 6 the internal and external *Genio-hyoides*: He moreover prepared the *Columella*, or *Uvula* with its muscles, of which there are two pair; *viz.* the internal and external *Pterygo-staphylinus*; he raised the muscles of the *Cartilago scutiformis*, of which there are three pair. 1. The *Sterno-thyreoides*. 2. The *Crico thyreoides*. 3. The *Hyo-thyreoides*; as also the muscles of the *Cartilago arytænoides*, of which there are four pair. 1. The *Thyreo-arytænoides*. 2. The *Arytænoides* or *Sphincter*. 3. The lateral *Cricoarytænoides*. 4. The posterior *Cricoarytænoides*; then the muscles of the *Pharynx*, of which there are three pair. 1. The *Stylo pharyngæus*. 2. The *Spheno-pharyngæus*. 3. The *Cephalo-pharyngæus*, which are rather the fleshy beginning of the *Oesophagus* than muscles; and likewise the muscle called the *Oesophagæus*, which constringes the *Gula*. *Observat.* 1. That in a spurious *Angina* the *Tonsillæ* are inflamed, but in the legitimate, the muscles of the *Larynx*, especially the *Arytænoides*. 2. *Marchetti* the elder cured a legitimate *Angina*, by making an incision in the *Larynx* between the two superior *Annuli*, and introducing a silver pipe into

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into it, thro' which the patient performed inſpiration and exſpiration; after the ſurgeon has made the inciſion, he muſt divide a little, and nicely draw aſide the *Sterno-hyoid* and *Sterno-thyreoid* muſcles. 3. *Marchetti* affirmed, he had obſerved a ſmall ramification of the *Ductus thoracicus*, or *chyliferus* tending to the *Pericardium*, into which introducing a blow-pipe, he inflated the *Pericardium*, from whence he reaſonably conjectured, that the *Lympha* was derived into it. 4. That the human lungs externally reſemble an ox's hoof. 5. That the ramifications of the *Aſpera arteria*, or *Bronchia* within the lungs, have no annular cartilages. 6. That the valves of the *Vena cava* are called *Tricuſpides*; thoſe of the *Arteria venoſa*, *Mitrales*, becauſe, both together, they in ſome meaſure repreſent a Biſhop's mitre; thoſe of the *Vena arterioſa* are ſtiled *Sigmoides*, and thoſe of the *Aorta*, *Semilunares*; the *Pericardium* in this ſubject was preternaturally faſtened to the diaphragm at its point; we obſerved two glands below the *Larynx* under the *Sterno-thyreoid* muſcles, on each ſide of the *Aſpera arteria*, which in a *Bronchocele* (to which the inhabitants of the *Alps*, and high mountains are ſubject) ſwell exceedingly; he moreover obſerved, that the *Thoracic* duct ſends a branch to the parotid gland.

Marchetti raiſed the muſcles of the back; *viz.* 1. The *Trapezii* or *Cuculares*, ſo called from their figure, of which *Veſlingius* treats at large. 2. The rhomboid muſcles, which terminate in the baſis of the *Scapula*. 3. The *Levatores Scapulæ*, called *Muſculi patientiæ & pauperum*, becauſe, when poor people are denied charity, they ſhrug up their ſhoulders, and cry, *we muſt have patience*. 4. The *latiſſimus Dorſi* inſerted into the top of the cubit, and from its office called *Ani-ſcalptor*. 5. The ſuperior *ſerrati poſtici minores*. 6. The inferior *ſerrati poſtici majores*. 7. The *longiſſimus Dorſi*, which runs along the whole length of the back, and at its origin uniting with the *ſacro-lumbares*, beſtows on each rib two *anſulæ*, or nervous tendons, which decuſſate each other in the manner of a croſs; *viz.* the external *anſulæ* tend upwards, and the internal downwards. 8. The *ſacro-lumbares*, which at their origin being joined internally to the preceeding, and to the ſpinal proceſſes of the *Vertebræ*, extend to the neck, and at the ſame time beſtow *Anſulæ* on each rib, but its external *Anſulæ* are carneous and not tendinous, as thoſe of the preceeding. 9. The *ſemiſpinati*.

He likewiſe raiſed the muſcles of the head and neck, and 1. The *Splenii*, ſo called, becauſe they repreſent an ox's ſpleen; they are inſerted into the *Occiput*, and ſend (which is not ob-

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ſerved by *Veſlingius* and other anatomiſts) a pretty ſtrong tendon, divided from the reſt of its body, to the tranſverſe proceſs of the ſecond *Vertebra* of the neck. 2. The *Muſculi complexi*, ſo called, as they ſeem to conſiſt of ſeveral muſcles. 3. The *Recti majores*, or *externi*. 4. The *Recti minores*, or *interni*, ariſing from the tubercles of the firſt *Vertebra*. 5. The *Obliqui ſuperiores*. 6. The *Obliqui inferiores*. 7. The maſtoid muſcles. 8. The *Longi*. 9. The *Scaleni*. 10. The *Tranſverſales*. 11. The *Spinati*; and at laſt he raiſed the *ſacri & quadrati*: He ſhewed the muſcles of the face; in the forehead the *Membrana carnoſa* degenerates into a muſcle, beginning to be double, where the hair of the head ends. *Obſervat.* 1. That the muſcles which move or divide the lips obliquely, and called *Sardonii*, ſhould be cut in the diſeaſe called *Riſus ſardonicus*. 2. That if the head be anointed with the fat of a human ſcull, the hair will grow plentifully. 3. That the inteſtines of ſuch as die of a malignant fever, appear of a livid colour, or of a green blue. 4. That the *Pericranium* does not differ from the *Perioſteum*, only that the *Perioſteum* on the head is called the *Pericranium*, and it may be divided into 7 or even 10 portions. 5. That the temporal muſcles are covered for their defence, and in order to retain them in their ſituation, with a proper membrane, which ſome have miſtaken for the *Pericranium*; we muſt be careful not to hurt this membrane; for a wound therein often cauſes convulſions, and hence ſuch wounds are reckoned mortal.

Marchetti raiſed the muſcles of the face; the two muſcles of the noſe; *viz.* the *Triangulares & obliqui*; the *Sphincter* of the eyelids; the *Elevatores* of the upper lip, of which there are two pair, one common to the lips and noſtrils, taking its origin from the interior angle of the eye; the muſcles that ariſe from the *Os jugale*, and therefore called *Zygomatici*, are to be cut in the *Riſus Sardonicus*; he obſerved, that theſe muſcles are wanting in ſome perſons; then he ſhewed the *Conſtrictor*, or *Sphincter Labiorum*, called by ſome the *Muſculus baſiatorius*; the *Depreſſores* of the inferior lip ariſing from the bottom of the chin, are very ſpongy, where the beard grows; the other pair, which draws downwards both the upper and lower lip, is inſerted into the angles of the *Sphincter* or mouth; he alſo ſhew'd the muſcles of the lower jaw-bone; *viz.* the *Temporalis*, the *Maſſeter*, the internal and external *Pterygoides*, all which draw the jaw-bone upwards; next the *Diagaſtrici*, which depreſs it. *Obſervat.* 1. That in the operation of the *Trepan*, you muſt keep clear

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clear of the ſutures; for if the *Dura mater* (which communicates with the *Pericranium* thro' the ſutures) be hurt, there is great danger of the patient's dying convuls'd. 2. The human brain is large, in proportion to the bulk of the body. 3. *Marchetti* obſerved two bodies in the ventricles of the brain, called by *Arantius* from their reſemblance *Hippocampi & Bombyces*. 4. The brain has no pulſation of itſelf, but what it has from its arteries; for if you open the ſcull of a living animal, and lay bare the brain, and remove a portion of the *Pia mater* together with its veſſels, you may obſerve a pulſation in another part, whilſt this that is ſtripped of its membrane has none at all; *Marchetti* affirmed, that he himſelf had obſerved this, and that the brain after removing the ſcull, had a pulſation that continued upwards of $\frac{1}{4}$ of an hour. 5. We obſerved the fourth pair of nerves, or *par Fallopianum*, which ariſing from the poſterior part of the brain, creeps along the ſides of its baſis, and goes out near the third pair. 6. He obſerved, that ſeveral nerves of the ſeven conjugations were not ſimple, tho' they went out at one *Foramen*, but were really divided, and manifold; *viz.* the third and fifth pair conſiſted of four nerves each; the ſixth pair of 8 or 10; tho' all theſe together were not ſo large, as Mr. *Ray* had ſuppoſed. 7. That the pituitary gland is larger and firmer in men, than Mr. *Ray* had ever obſerved it in other animals. 8. *Marchetti* ſhewed under the membrane of the *Infundibulum*, two white ſmall bodies of the bigneſs of a vetch, and ſhaped like a teſticle, which he ſaid his brother had firſt diſcovered; tho' they are delineated by *Veſlingius*. 9. Mr. *Ray* obſerved in the large *Foramina* of the noſtrils four or more oblong, ſpongy bodies, covered with a membrane, which probably hinder the *Mucus* from running down. 10 The *Pia mater* ſeems to conſiſt of the coats of veins and arteries, which in ſeveral ramifications creep along its ſubſtance: Next, *Marchetti* came to the diſſection of the eye, in which he obſerved ſix muſcles. 1. The *Elevator*, called *Superbus*, & *Hiſpanus*. 2. The *Depreſſores* called *humiles* & *Capucini*. 3. The *Adductors*, called *Bibitorii*, & *Germani*. 4. The *Abductors*, ſtiled *Meretricii*. 5. The oblique, and 6. The *Trochleatores*, called *Amatorii*; the anterior coat only of the cryſtalline humour is called *Aranea*, and the poſterior coat is reckoned a part of the *Hyaloides*; he obſerved the nerves that entered into each muſcle of the eye.

The *Veſiculæ ſeminales* lie like wings on each ſide of the *Vaſa deferentia*, immediately above the proſtate glands, and take their riſe near them; the *Capſulæ ſeminales* are no other than the *Vaſa* defe-

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deferentia dilated, immediately above the proſtate glands; common proſtitutes have the art of ſtreightening the *Vulva*, *in Coitu*, by inwardly protruding the *Os coccygis*, ſo as thereby to heighten the pleaſure of copulation.

Marchetti obſerved in a ſubject, that the ſpermatic artery, taking its origin below from the trunk of the *Arteria magna*, aſcended, and paſſed over the emulgent artery; the *Capſula ſpermatica* was plainly ſeen perforated to the *Urethra*, and likewiſe even to the *Veſiculæ ſeminales*, ſo as eaſily to admit a probe into each; the *Foramen*, that opens into the *Urethra*, thro' the tubercle in the neck of the bladder, or the caruncle in the beginning of the *Urethra*, has a valve, which hinders either the involuntary diſcharge of the *Semen*, or its return again to the *Capſulæ*; *Marchetti* affirmed, he never found any *Semen* in the proſtate glands, nor any *Foramina* to diſcharge the *Semen* into the *Urethra*; Mr. *Ray* is of a different opinion, and ſuppoſes, that *Semen* is contained in theſe glands, even in men; *Marchetti* ſuppoſes, that theſe glands were deſigned to compreſs the neck of the *Veſica*, and ſo contribute to a ſtronger ejaculation; at the extremity of the *Urethra*, or *Glans Penis*, the canal dilates itſelf, and forms a *Sinus*, in which if a ſtagnation of any acrid or putrid matter happen, whether *Semen* or urine, it cauſes exquiſite pain, and produces puſtules: The yellow *Gonorrhœa*, excites very violent pains.

Marchetti diſſected the muſcles of the hand, which are, 1. The *Deltoides*. 2. The *Coracoides*, which ſerve to raiſe the *Humerus*. 3. The *Rotundus major*. 4. The *Rotundus minor*, which depreſs the *Humerus*. 5. The *Spinatus inferior*. 6. The *Spinatus ſuperior*. 7. The *Infra-ſcapularis*, or *Demerſus*, which are ſuppoſed to move the *Humerus* round. 8. The *Biceps*, chiefly remarkable for its double origin, one of which is inſerted by its tendon into the *Sinus* or *Foveola*, formed in the head of the *Os Humeri*. 9. The *Brachiæus*, which bend the cubit. 10. The *Longus*. 11. The *Brevis*, which are joined together. 12. The *Anconæus*; theſe together extend the cubit. 13. The *Quadratus*. 14. The *Teres*, which are called the *Pronatores*. 15. The *Supinator longus*. 16. The *Supinator brevis*. 17. The *Palmaris*, expanded over the whole palm of the hand. 18. The *Flexor Carpi externus*. 19. The *Flexor Carpi internus*. 20. The *Extenſor Carpi externus*. 21. The *Extenſor Carpi internus*. 22. The *Flexores* of the firſt internode, called *Lumbricales*, ariſing fleſhy from the tendons of the *Flexores* of the ſecond internode. 23. The *Flexores* of the ſecond internode, called the *Perforati*.

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forati. 24. The *Flexores* of the third internode, ſtiled *Perforantes*. 25. The *Abductor* of the little finger. 26. The *Abductor* of the ring-finger. 27. The *Abductor* of the middle finger. 28. The *Abductor* of the fore-finger, called *Indicator*, a very remarkable muſcle. 29. The *Adductor* of the fore-finger. 30. The *Adductor* of the middle finger. 31. The *Adductor* of the ring-finger. 32. The *Adductor* of the little finger; theſe muſcles croſs each other, and are called *Interoſſei*. 33. The *Flexor* of the firſt internode of the thumb. 34. The *Flexor* of the ſecond internode, which may be divided into four parts. 35. The *Adductor*. 36. The *Abductor* of the thumb. 37. The *Flexor* of the third internode. 38. The firſt *Extenſor* of the thumb. 39. The ſecond *Extenſor* of the thumb. 40. The *Extenſores* of the fingers, which envelope, as it were, each joint.

Marchetti the younger, performed the operation of cutting a child out of the womb called *Partus Cæſareus*; he affirmed, he extracted a child which lived two or three days, out of the mother's womb, after ſhe was dead; the manner of the operation is as follows; make an inciſion on one ſide, or on that ſide where the child's head is found to lie, but obſerve to keep clear of the *Linea Alba*, and the parts near it, becauſe of the tendons of the muſcles, which all meet here, and the difficulty there is of their coaleſcing again, if cut; in making the inciſion take particular care to cut gradually and gently, for fear of wounding the inteſtines; and when you have perforated all the muſcles and *Peritonæum*, then introduce two of your fingers, and raiſe up all the ſaid muſcles and *Peritonæum*, and cut, directing your fingers upwards towards the knife; and likewiſe in opening the *Uterus*, you muſt be very careful not to wound the *Fœtus*; and after extracting it, ſew up the orifice, by paſſing a needle thro' the muſcles and membranes, and let the threads be connected together in each puncture; the *Uterus* itſelf is by no means to be ſewed up; after this make an injection into the *Uterus* of a decoction of *Sanicula*, *Conſolida*, and other vulneraries, as alſo of the roughſt wine; to the external wound of the *Abdomen*, firſt apply pledgets of lint, dipped in the whites of eggs, and then plaiſters, as *Diapalma*, &c. but if the wound comes to a ſuppuration put a tent into its lower part: *Marchetti* affirmed, he could never obſerve the *Oſſa Pubis* ſeparated in child-birth; for he himſelf had, in very hard labours, put his hand upon that part, and yet he could not perceive any ſeparation or oblongation therein; there is alſo an argument from *Hippocrates* againſt this opinion, taken from the *Callus*, which grows

grows between broken or luxated bones, and ever after hinders their ſeparation.

In a hare, which was diſſected, the *Rectum* was obſerved of a very great length, with large *Pilulæ* of excrement; Mr. *Ray* calls this gut (in ſo far as it had no *Cellulæ*) *Rectum*, tho' indeed, it had one or two convolutions; the *Cæcum* was of a vaſt bigneſs and length, far exceeding the *Colon*, and full of *Fæces*; juſt at the entrance into it out of the *Ileum*, there was another *Appendix* of a globular figure; its coats were more fleſhy, and fuller of veins and arteries than the adjoining *Cæcum*; it had alſo a ſmall round hole; the *Cæcum*, towards its further extremity, was ſmall round, fleſhy, full of veſſels, and red-coloured, like the *Jejunum* in men; the inner coat was granulated, and that upwards of four inches in length; the ſpleen was ſmall and long, and thicker at one extremity, it had no gall-bladder that Mr. *Ray* could diſcover (tho' in another hare the gall-bladder was manifeſt) the kidneys were large, and the left higher than the right, the *Glandulæ renales* did not receive their veſſels from the emulgents, but from large veins, that on each ſide went to the loins; the ſtomach was full of fir chewed ſmall, as Mr. *Ray* ſuppoſed, from its ſmell; it was a female hare, and had long *Cornua Uteri*, but was not pregnant, at the time of cutting it up; it ſeemed to have ſuch another cavity under the tail, above the *Foramen Ani*, as Mr. *Ray* had obſerved in a badger.

Mr. *Ray* obſerved in a mountain-hen two *Appendices*, upwards of half an ell long, as he ſuppoſes; at their origin from the *Rectum* for three or four inches, they are reflected or convolved; but in the firſt convolution there were no *Fæces*; then they mounted upwards near the *Rectum* on each ſide, and were very large, and full of *Fæces*; at their entrance, where they adhere to the *Rectum*, they have as it were, an annular muſcle, or ſphincter; the liver was pretty large, divided into two principal lobes; Mr. *Ray* found no gall-bladder, but two large biliary pores, which by different orifices not far diſtant from each other, opened into the *Duodenum*; the ſpleen was ſmall and triangular; the gizzard of a middle ſize, and muſcular, and its inner coat in ſome parts concreted into a ſubſtance almoſt as hard as horn; the heart was very large; in the gizzard and crop were found the tops and buds of fir-leaves, which upon opening emitted a reſinous and grateful ſmell, much reſembling that found in the hare's ſtomach above-mentioned.

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Hydatides *inclosed within a stony Crust in the Kidney of a Sheep; by Mr.* Cowper. Phil. Trans. N° 307. p. 2304.

MR. *Cowper* found in a sheep's kidney a large whitish body, inclining to yellow, and tinged with red, as it lay under the membrane of the kidney; it was very hard, as is usual in animal petrifactions, and ⅓ of it lay hid within the substance of the kidney; it was inclosed within a thick hard membrane, that could not easily be separated therefrom, even with a needle fixed at the end of a stick; the branches of the emulgent veins and arteries, lay between it and the *Pelvis* of the kidney, all which vessels were somewhat compressed by this petrified body; as Mr. *Cowper* was picking off its thick, strong, membranous cases, he found the needle slip at a small aperture into a cavity, by which he discovered, that this hard, heavy, petrified body was hollow; and finding a membranous interstice therein, he pulled it asunder, and found its inside divided into several petrified cells of irregular figures, and filled with *Hydatides* of various sizes and shapes.

A Description of the Pædiculus Cæti; *by Sir* Robert Sibbald. Phil. Trans. N° 308. p. 2314.

THE *Pediculus Cæti* is the *Balanus Balænæ cuidam Oceani septentrionalis adherens.* Lister *Hist. Conchil. Bocconi* in his *Recherches & Observations naturelles*, was the first that mentioned it, whose description of the shell is better than the figure, he has given of it: The shell according to Sir *Robert Sibbald*, approached to an hexangular figure, consisting of one valve, wherein it differed from all the *Balani* he had seen; it had no spiral circumvolutions, nor *Apex*, but opened at both extremities; the orifice of its upper extremity was narrower, and thro' it the animal exerts its *Cirrhi* or *Brachia*; the orifice of the lower extremity was much broader, and therein the animal lodged; the lower is divided, as *Bocconi* observes, into 18 lines, that are rais'd, 12 of them simple and streight, and the other 6 branched; the last are placed in such a manner, that there are two streight lines betwixt each of them, and there is a cavity between all these lines, in which the *Cirrhi* or arms of the animal are probably lodged, tho' in this subject they stood in the middle of the upper part of the shell, with their extremities contracted; for the upper orifice is deeper than the lower; and there is an aperture from the under part to the upper, by which the *Cirrhi* mount from the head of the animal; the orifice of the upper part is narrow below, but

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wide in the middle, and then again it contracts somewhat; the body of the shell is convex, and has six divisions, each consisting of four protuberant tubes, which are narrower at the upper extremity, but become sensibly wider towards the lower end; the outermost of these tubes are narrow, the middle tubes are broader, and all of them have *Striæ* crossing them; the distances between their parts are smooth, and appear hollow; their superficies are wider at the top, and grow sensibly narrower towards the bottom; all the tubes are hollow on the inside, forming cavities both between the simple and branched lines, which compose them; they arise from the orifice in the middle of the inner part of the shell, and proceed towards the sides, the branched part being nearest the side of the shell; in the upper part of the animal itself, there appeared somewhat resembling a gaping mouth; both the upper and lower parts were semicircular, but narrower towards the point of the aperture; they were membranous, and took their rise from the inside of the shell; the upper lip, if it may be so called, was altogether membranous, and the lower seemed to be of an osseous consistence towards the shell, and appeared like the *Dentes molares*; a little below the mouth appeared the *Cirrhi*, which were continued to the rest of the body of the animal; Sir *Robert Sibbald* does not doubt, but that, when the animal is alive, the under part below the *Cirrhi* resembles the under part of the *Molluſci* of the polypode kind; this resembles the *Parenchyma* of a *Buccinum*, but was much firmer, and when squeezed it yielded a fat juice; it was white on the outside, but blackish where it adhered to the shell; it was all contracted within the under part of the shell, which it filled; the animal was somewhat exsiccated, so that Sir *Robert* could not perceive any distinction of parts therein, tho' some suppose that the *Viscera* and other vessels may be traced therein, when newly taken; two sinewy bodies, arose from the sides of the upper part of the shell, exactly opposite to each other, and terminated in two claws; and by these it is probable the animal sticks to any thing, and by them it adhered to the whale; it can dilate and contract them at pleasure: This animal is a new species of the *Polypus* kind, which seems to be peculiar to some sort of whales in the seas adjacent to *Scotland*.

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An Account of a Hydrops Ovarii, *&c. by Dr.* Douglaſs. Phil. Tranſ. N° 308. p. 2317.

DR. *Douglaſs* opened the body of a woman, of 27 years of age, who died the third day after delivery, on which he made the following remarks: 1. She meaſured round the waiſt, a yard and three quarters, and from the *Scrobiculus Cordis* to the *Os Pubis*, a yard and a quarter. 2. All the cutaneous veins of the *Abdomen* were of a very unuſual and extraordinary bigneſs, and very much diſtended with blood; and upon opening the largeſt of them, he extracted ſeveral polypous concretions. 3. The *Cuticula* from the *Umbilicus* downwards appeared rough, and ſcaly to the naked eye; in ſeveral places it ſeemed mortified, occaſioned, probably, by the ſharpneſs of the *Serum*, that continually ouzed out of it, when ſhe ſcratched the little pimples or wheals that aroſe on its ſurface; theſe for ſome time were wont to go off without any ſcar, but as her ſtrength decayed, they became mortified. 4. The external integuments, on all the *Regio epigaſtrica*, were very thin, there appearing little or no fat; but from the upper part of the *Regio umbilicalis*, down to the *Os Pubis*, the ſkin was almoſt ¼ an inch thick, of a whitiſh colour and hard, ſome of it appearing as if it were granulated, cauſed by ſome obſtructions in the milliary glands of the ſkin. 5. The fat under this part of the ſkin was upwards of an inch thick, being diſtributed into ſeveral lobules of an irregular figure, and lodged in ſo many cells, adhering to the *Membrana adipoſa*, which in this place was alſo much thicker than it uſually is in a natural ſtate. 6. Her thighs, legs and feet were all anaſarcous, being exceedingly ſwelled, and eaſily retaining any impreſſion made by the fingers; and the Dr. was told by her nurſe, that ſhe uſed to wet a great deal of linnen in drying up the water, that would always iſſue out from theſe parts on the leaſt rubbing, yet all her ſuperior parts were exceedingly emaciated. 7. The fleſhy part of the abdominal muſcles was much extenuated by that great diſtenſion, yet their tendons were as thick as uſual, and being very eaſily ſeparable from each other, the Dr. plainly obſerved, that the tendon of the *Obliquus internus* adhered cloſely to that of the *Tranſverſalis*, along the edge of the *Muſculus rectus*, and was not double as *Realdus Columbus*, and all anatomiſts after him, down to *Diemerbroeck* (who was firſt aware of this miſtake) have maintained; however, this ſtreight muſcle derives the ſame benefit from this ſituation, being hemmed in, as it were, on one ſide by this cloſe adheſion, and on the other ſide by the *Linea alba*, as if it

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had been inclosed between the two supposed tendons of the *Obliquus ascendens*; that is, it is much strengthened thereby, in time of acting; he also observed, that the tendons of the two oblique muscles, and the fleshy part of the *Transversalis*, between the anterior spine of the *Os Ilium* and the *Pubis*, near its commissure, did inseparably unite with each other, forming, as it were, a thick and hard border; from the outside of which, there was continued over the blood-vessels, nerves and muscles, on the fore-part of the thigh; a large *Aponeurosis* which braced them down, the two *Laminæ* of the membrane of the *Abdomen*, being expanded on its inside; now this border is what authors call the *Ligamentum Pubis*, and what Dr. *Douglas* in his *Myographia Comparativa*. p. 5. supposes to be the firm union of the tendons of these three abdominal muscles with the *Peritonæum*. 8. Having perforated the *Abdomen* in the most convenient depending part, there issued out in a rising stream with great impetuosity a vast quantity of slimy viscid water, in colour and consistence very much resembling a brown, thick and ropy syrup; this water measured between 16 and 17 gallons, besides what was lost on the floor, and imbibed by sponges and linen made use of in drying it up. 9. When the water was quite emptied, the Dr. at first supposed, that it had been all contained in a duplicature of the *Peritonæum*, and had caused a dropsy in that membrane, because none of the *Viscera* appeared; for in such a case, the Dr. had often observ'd that the inner *Lamella* of that membrane of the *Abdomen*, being separated from the outer, is forced inwards by the weight of the water upon the bowels, to which it closely adheres, contracting the guts and mesentery into a very small compass; but upon a narrower view, he perceived, that the thick membrane inclosing the water, could be easily separated from the *Viscera*, having freed it from its adhesions by membranous filaments to the *Peritonæum*, and by blood-vessels to the *Omentum*; now, this bag reached from the *Pubis* to the midriff, and from the left region of the loins to the right; in a word, it filled up the whole cavity of the *Abdomen*, distending her belly so far, that a plate could easily lie upon it, when she was alive; the Dr. having gradually separated it from all the neighbouring parts, and rolled it up, found that it adhered inseparably to the left *Tuba Fallopiana*, the spermatic vessels being ramified thereon; and observing no *Ovarium*, which in the other side was naturally disposed, he concluded, that the bag was nothing but the membrane of the *Ovarium*, covering the *Ova*, preternaturally thickened and distended by the collection of the above-mentioned humour, and that the distemper was a

true

tree *Hydrops Ovarii*; inasmuch as all this vast quantity of water was included in one bag, and all of the same colour and consistence. 10. All the other *Viscera* in the *Abdomen* were sound, and in their natural state. 11. In both cavities of the *Thorax* there was contained a large quantity of reddish water. 12. The liquor in the *Pericardium* was very plentiful, and of a greenish hue. 13. The right lobe of the lungs adhered to the membrane of the *Thorax*, covering the upper part of that cavity, but the left lobe was free from any adhesion. 14. In the left ventricle the Dr. found a large *Polypus*, or serous concretion, of a round figure, white colour, and of a pretty hard consistence, with several long roots of a red colour, which extended thro' the auricle, and bulb of the pulmonary vein into its nearest divarications in the lungs.

The Dr. having viewed this large bag, with the *Uterus* appendent to it, and cut off below the orifice of the *Meatus urinarius*, observed, 1. That the right spermatic vein, which opens into the *Cava* a little below the emulgent, was three times larger than the left; and from a little above the *Ovarium* it was continued, without any division to its termination. 2. The right *Ovarium* was in a very natural state; the *Cicatrix* or *Caruncula*, whence the fecundated *Ovulum* had dropped, was still remaining, and the blood-vessels were ramified upon this *Testis*, in a very agreeable manner. 3. The *Tuba Fallopiana* with its *Fimbria*, were all in a natural state. 4. The diameter of the left spermatic vein, which opens into the emulgent of that side, was smaller than ordinary; and from the extraordinary narrowness of the bore of this vessel we may assign a probable cause of this watery swelling; for the blood being retarded in its reflux to the heart, a great deal of *Serum*, or *Lympha*, by reason of its slow return, must needs be thrown off upon the *Ovarium*, already indisposed, whence the gradual increase of the tumour proceeded. 5. The two spermatic arteries were contorted and full of windings from their meeting with the veins, to the *Ovaria & Tubæ*. 6. A little below the kidneys, each artery sent out a branch, which was lost in the *Peritonæum*, and fatty membrane of the kidney; and from the same places, the veins received two considerable branches. 7. One of the arteries went off by a narrow orifice from the side of the *Aorta*, and the other arose from its middle, a little below the first. 8. Between the bag and the *Uterus* all these vessels were much dilated, forming several circumvolutions upon the *Peritonæum*, called in this place the *Ligamentum latum Uteri*. 9. The left *Tuba Fallopiana* was only remark-

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remarkable in its being much longer and larger than usual. 10. In the bag, which was nothing but the membrane called *Dartos*, that covers all the vesicular glands of which the *Ovarium* consists; he observed several little bladders of different sizes, and distinct from each other, which contained a limpid, or clear slimy *Serum*, in colour and consistence like a mucilage of the *Semen Cydoniorum*, and these were either hydatical tumours only, or the *Ova* themselves distended; this liquor was, by a slow heat, hardened into the consistence and colour of the white of an egg. 11. All the *Fundus Uteri* was about an inch and ½ thick, but near the *Collum minus* it became somewhat thinner; which was owing to the distention of its spongy and vesicular substance, by the blood in the vessels running thro' it in various meanders; so that when it was cut, it very much resembled the substance of the lungs. 12. Upon wiping the inner membrane of the *Uterus* with a sponge, the Dr. observed several small eminencies, which he took to be the glands mentioned by *Malpighius*, that separate an humour to lubricate and moisten its cavity. 13. On the upper part of the *Fundus uteri* he observ'd a great number of small vessels, like slender filaments or threads, running off from its membrane, and terminating in a reddish and soft spongy sort of substance, not unlike the *Uvula*, abating its colour, which hung down from that side of the *Uterus* in form of a nipple; these perhaps, are the vessels, which according to some, do separate and secern the matter of the *Lochia* and *Menses*, for they are visible only at those times. 14. Near the origin of the *Tubæ*, he perceived two tubercles, or little bunchings, about the bigness of a nut, to which, perhaps, the *Placenta* was fastened, and to these adhered several glands of a blackish colour, and different sizes. 15. The *Collum minus* was composed as it were, of two *Labia*, the uppermost was the most protuberant, and upon it he observed several small glands, out of which upon compression, issued a viscid clear liquor, said to seal up this part, in time of pregnancy; the lower *Labium* was longer and thinner, with its edges cut, or indented in several places. 16. The *Rugæ* in the lower part of the *Vagina* run as they are commonly represented, but these in the upper part had a quite different course as in Plate I. Fig. 2. 17. Near the orifice of the *Meatus urinarius*, two very large carunoles were observable, shaped like a mulberry.

In the next place the Dr. relates the symptoms of her big belly, and the method used for her recovery: Not long after this woman had laid in of her first child, she had a violent blow upon

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upon the left side of her belly, very painful for the time, but in two or three days, upon keeping herself quiet in bed, the pain and anguish went off; about two months after, she began to feel some little pain in the left hypogastric region, where she had received the blow; and she observed that side of her belly to grow considerably bigger than the other; these pains increased more and more, till they became very violent; but upon conception, which was three months after she was first afflicted with them, they went off, and her belly swell'd gradually, as is usual in pregnancy, having no other symptoms, but what are incident to that state, only she was much bigger than ordinary; and on that account she forbore the use of medicines, which possibly might have been of service in the beginning of her distemper, had she been well aware of her danger; after her delivery, the swelling and bulk of her belly continued much the same, as before the birth, only upon a plentiful evacuation of the *Lochia*, it decreased a little; when her month was up, she advised with several physicians, apothecaries, &c. who us'd emetics, strong cathartics, diuretic diet-drinks, and all the medicines commonly used in a dropsy, her supposed case; all the effect they had, was to prevent the farther increase of the swelling, while she used them; but after she entirely left them off, the tumour increased very remarkably; thus she continued about a year, and then she conceived again, as she suspected by the stoppage of her *Menses*, which were always very regular, but at such a time; her appetite was always good, she never was very thirsty, and so drank but little; she made water freely and in a large quantity, without any of the symptoms of an *Ascites*, excepting the swelling of her belly; only when she was half gone with child, her legs began to swell and pit, growing very big all of a sudden; from which and likewise from her belly, there would often issue out a great deal of a watery humour upon rubbing, as has been already observed; especially if she scratched the little pimples, that would often arise in those parts; about this time, she began to be afflicted with a difficulty of breathing, with a violent trembling and palpitation of the heart, and to be often subject to deep and involuntary sighings; she could not lie down, but was obliged to sleep in a sitting posture, for fear of being choak'd: Now, Dr. *Douglas* thinks it probable, that all these symptoms proceeded from the large quantity of water contained in the cavities of the *Thorax* and *Pericardium*; which doubtless did more effectually hasten her end, than the bigness of her belly, with which she might have lived several years.

In

In Plate I. Fig. 1. represents the *Glandulæ renales*, the *Uterus* with the parts belonging to it, and the large bag or membrane of the *Ovarium* preternaturally distended; *a* the *Glandula renalis* on the right side; *b* an eminence or rising in its middle; *c* a vein that runs from it to the *Cava*; *d* the *Glandula renalis* on the left side; *e* a *Sulcus* or furrow in its middle; *f* a vein running from it to the emulgent; *g* a small vein that comes from the diaphragm, and opens into this vein, before it leaves the gland; *h h* two small arteries from the *Aorta*; *i i* two nervous twigs from one of the intercostal *Plexus's*; A A the kidneys; B B the ureters cut off; C the *Cava* cut off; D its division into the *Rami iliaci*; E E the internal branches into which the hypogastrics open; F F the emulgent veins; G the *Aorta* cut off; H its division into the iliacs; I I its internal branches, which are spread upon the *Uterus*; K K the external iliacs of both vessels; L L the emulgent arteries; M M the spermatic veins; N N N N the spermatic arteries, very much contorted in their progress, that on the right side being cut off; O the union of the branches of the spermatic vein on the right side; P the right *Ovarium*, with ramifications of blood-vessels on its outer membrane; Q the right *Tuba*; *q* its *Fimbria*; R the *Tuba* on the left side, with its *Fimbria* adhering to the large bag; S S S the membrane of the left *Ovarium*, distended to a vast bigness, with the ramifications of blood-vessels thereon; T some of the *Ovula* grown big; W some hydatidal tumours on the inside of the large bag; V V V the *Ligamenta lata*; U the *Fundus Uteri*; X X the *Ligamenta rotunda*, the membrane that covers them being laid open, in order to shew the vessels of which they are composed; Y the *Vagina* cut off; Z the *Vesica urinaria*; * * a small artery and vein on each side, the first going off from the spermatic, is spread upon the *Membrana adiposa* and *Peritonæum* under the kidney; the latter bringing back the blood from these parts, opens into the spermatic vein. Fig. 2. shews the *Vagina* and *Uterus* cut open; A A A the *Fundus Uteri* laid open, and its sides folded back to shew its internal spongy substance, with the orifices of the hysteric vessels; 2 2 the glands appearing on the inner membrane of the *Uterus*, 3 3 the small vessels, by which the *Lochia*, &c. are separated; 4 a soft substance, hanging down from the upper part of the *Uretus*, in which the aforesaid vessels terminate; 5 two tubercles seated near the origin of the *Tubæ*, to which the *Placenta* adhered; B B the *Vagina* laid open; 6 6 the two *Labia* of the *Collum minus*; 7 7 several small glands placed on the upper *Labium*; 8 the course of the *Rugæ*, on the upper side of the *Vagina*; 9 9 their

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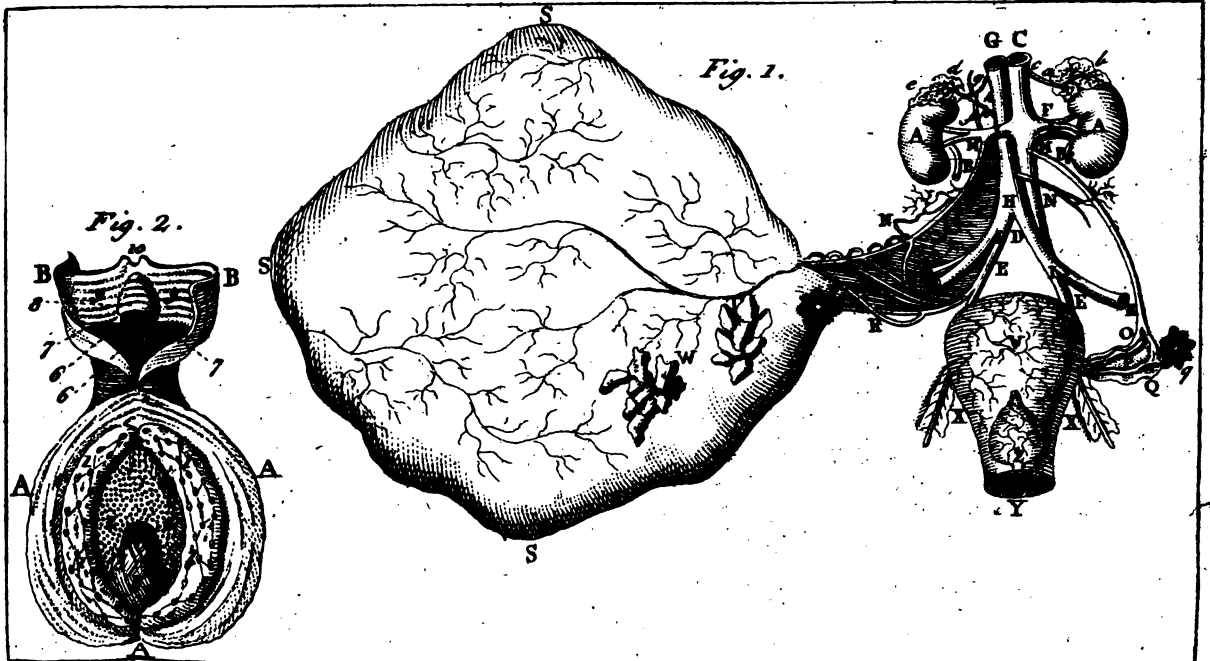
PLATE. I.



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9, 9 their direction on the under ſide of that part; 10, 10 two orbicular ſubſtances, near the orifice of the *Meatus urinarius*.

An Experiment *ſhewing the extraordinary* Electricity *of* Glaſs, *produceable on a ſmart* Attrition, *&c. by Mr.* Francis Hauksbee. Phil. Tranſ. N° 308. p. 2327.

MR. *Hauksbee* took a hollow tube of fine flint glaſs, about an inch in diameter, and 30 inches long, and after rubbing it pretty ſmartly with paper, till it acquired ſome degree of heat, he then held it towards ſome pieces of leaf-braſs, and as ſoon as the effluvia of the glaſs reached them, they were ſuddenly put into motion, flying towards the tube, even at 9 or 10 inches diſtance; and it ſeemed by how much hotter the tube was made by rubbing, it would attract at the greater diſtance; but that it would do ſo to any degree of heat, Mr. *Hauksbee* could not determine; and what was farther obſervable, was, that ſometimes the bodies attracted would adhere to the tube, and there remain at reſt; ſometimes they would be thrown violently from it to a good diſtance; ſometimes in their moving towards the glaſs, at other times even on their touching it, they would be ſuddenly repelled to the diſtance of four or five inches, repeating the ſame ſeveral times with great velocity in a very ſurpriſing manner; ſometimes the bodies attracted would move but ſlowly towards the tube, at other times they would remain ſuſpended for ſome little time between the glaſs and the table, on which the braſs-leaf was laid; and ſometimes they would ſeem to ſlide along the ſides of the glaſs without touching it; all theſe *Phænomena* Mr. *Hauksbee* obſerved at ſeveral times, and he found them in a great meaſure agreeable to this account, tho' the force and vigour of the effluvia is ſometimes leſs, than what it is at other times; which ſeemed to him to proceed from the different temperature of the air at the time when the experiments are made; for when it happens that a great many humid particles ſwim in the air, no doubt, the reſiſtance of ſuch particles muſt very much impede the force and extent of the effluvia; or they may ſuddenly condenſe on the warm tube, and thereby hinder or choak the paſſage of the effluvia; for he found that moiſtneſs was at all times inconſiſtent with trials of this nature; beſides the quality of the effluvia ſeems to be ſuch, that Mr. *Hauksbee* could not, with all his endeavours, cauſe them to affect one of the above-mentioned bodies thro' a piece of fine muſlin, tho' it was held very near the tube, and yet at the ſame time they would attract or give mo-

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tion to the ſame body at three or four times that diſtance, when the muſlin did not interpoſe; moreover, Mr. *Hauksbee* could not tell, but that the coldneſs of the air at the ſame time might concur; for when he firſt made this experiment, it was ſummer time and dry weather, and then it ſeemed to ſucceed ſomewhat better, than it did afterwards: But to proceed, when the glaſs became hotteſt by the greateſt attrition, it then emitted ſuch a quantity of effluvia, as not only to produce the abovementioned effect, but when nearly applied to the face, or any tender part of the body, to be ſenſibly felt, as if the points of a conſiderable number of weak hairs affected the part: Mr. *Hauksbee* attempted a diſcovery of the figure of their motion, by bringing the fricated tube near the flame of a candle, ſmoke, ſteam, duſt, and the ſurfaces of liquids, but without any ſucceſs; and this Mr. *Hauksbee* entirely attributed to the reaſon above-mentioned; *viz.* the ſudden condenſation of the humid effluvia on the warm glaſs; ſo that the oleaginous quality of the flame and ſmoke, the moiſtneſs of the ſteam, the ſmallneſs of the duſt, or effluvia of the liquids, would immediately adhere to all the parts of the fricated tube, as it was brought within their ſpheres of activity, preventing the operation of its effluvia, which then ſeemed to be ſtopped, or retired within itſelf, and required a new attrition to give it vent; what next occurred in this experiment was, that upon exhauſting the air from the tube, tho' a like attrition or greater was given it than before, yet very little of the effluvia could be diſcover'd, from any motion given the leaf braſs, notwithſtanding it was held within a quarter of the diſtance, at which it had been attracted before; after this had been continued for ſome time, with little ſucceſs, becauſe, ſmall particles of the leaf braſs, where the tube was held near, and at the ſame time very warm, had a motion given them; but not to be compared with what it had, when the experiment was made without exhauſting the air; beſides, Mr. *Hauksbee* did not doubt but, that ſome ſmall quantity of air might remain in the tube, and ſo the attraction might continue in proportion to the quantity of the remaining air; or the heat produced upon the ſmart attrition of the tube, as well in this as in other experiments, might ſupply the effect and ſpace of ſuch a quantity of air; upon readmitting the air, it was obſervable, that before any new attrition was given the tube, or before it was removed from the poſition and diſtance it was held at when *in Vacuo*, ſeveral of the abovementioned bodies, at reſt as to appearance, began ſuddenly to move and were ſome of them attracted towards the tube, which,

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upon a freſh attrition, recovered its electrical quality, as vigorou as at firſt: Upon the attrition of the tube in the dark, it was ver obſervable, that when the glaſs became warm, a light would con tinually follow the motion of the hand backwards and forwards; an at the ſame time, if another hand was held near the tube, a ligh would be ſeen to break from it with a noiſe, much like the crack ling of a green leaf in the fire, but not ſo loud; tho' when the experiment has been very ſilently made, Mr. *Hauksbee* has hear ſeveral cracks at ſeven or eight foot diſtance, or more; when an thing elſe, beſides the hand was brought near it, tho' it did n touch it, a light would fix upon it, as Mr. *Hauksbee* tried wit gold, ſilver, braſs, ivory, wood, *&c.* yielding much the ſan appearance as the hand; but after the glaſs came to be exhauſte of air, upon the firſt attrition, a much larger light enſue which appeared entirely within the tube; only upon the attritio of the unexhauſted tube, on its outſide; but in the former ca the tube ſeemed to loſe the quality of giving a light to a bod brought near it.

Mr. *Hauksbee*, upon trying a ſolid tube, about the ſame bi neſs and of the ſame metal with the other, found no great diff rence in its operations, only its effluvia ſeemed to continue a litt longer, but he could not diſcover, that it attracted at a greate diſtance than the other did: He took a little lamp-black, an drying it on a paper before the fire, and rubbing the tube till i was warm, and then holding it near the lamp black, it was a agreeable ſight to behold the briſk agitation of a great number o little bodies, ſeeming to aſcend and deſcend promiſcuouſly with great velocity; and it was ſurpriſing to obſerve bodies ſo light *in ſpecie*, and which with their proper gravity falling on paper, would make no ſenſible noiſe, return with ſuch force from the tube, that their ſtriking the paper was very audible.

Mr. *Hauksbee* procured a glaſs nearly cylindrical, about 7 inches in length, and as many in diameter; it was put into motion by a ma chine of a new contrivance; its axis lay parallel to the horizon, as in the like experiments formerly made, it was perpendicular thereto; after this cylinder was exhauſted of air, and put into motion by a wheel, it ſucceeded with reſpect to the light produced upon its attrition, as in the experiments above-mentioned; but when all the air was re-admitted, and the attrition and motion con tinued as at firſt, it was very ſurpriſing to behold, from the point of one's finger to the glaſs, a ſtrong light, which began firſt at the finger, and ſeem'd to gravitate thereon, being ſenſibly felt there, tho' the moving body was not within half an inch of it; this light ſeem'd to iſſue from the glaſs, with a conſiderable noiſe, (n

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much unlike that of wheezing, but ſmarter) and was eaſily diſtinguiſhable from that made by the operation of the engine, which was conſiderable; this experiment having been made in the dark, Mr. *Hauksbee* tried whether it would exhibit any phænomenon by day light; accordingly, in the afternoon between two and three o'clock, in a very light room, immediately after the attrition was made on the moving glaſs, and the finger brought near it as before, he obſerved a pure purple light very viſibly, extending itſelf from the finger to the cylinder, and accompanied with the above-mention'd noiſe; this experiment Mr. *Hauksbee* repeated ſeveral times at different hours, and with the like ſucceſs, being always made with a glaſs un-exhauſted of air; as to the electricity of this body upon the uſual motion and attrition given it, he did not find, that it exceeded in that quality, what he has already related in former experiments: Mr. *Hauksbee* then took a piece of fine muſlin, which was ſew'd to two wires, bent arch-wiſe, ſo as to ſurround the upper ſurface of the glaſs, almoſt four inches diſtant from it; he broke the threads of the muſlin, to make it as ragged as he could (for he found that ſmall and light bodies are moſt apt to be effected by the effluvia of glaſs) then the motion and attrition being given the glaſs, it was an agreeable ſight to ſee a great number of ſmall ſpecks of light every where on the extremities of the torn threads which reſembled ſo many little ſtars, obſervable thro' a good teleſcope, in the *Via lactea*; and the whole was attended with ſuch a whiteneſs, by the ſmall light proceeding from them, as is ſeen in that part of the hemiſphere with the naked eye; after that, Mr. *Hauksbee* tried whether the addition of heat, by placing a red hot iron juſt under the moving glaſs, would add to the appearance of light, but he found it ineffectual, without the attrition of his hand, and even with it, he could diſcover no greater effect, than if there had been no ſuch red hot iron, both with the exhauſted and unexhauſted glaſs: Mr. *Hauksbee* having always obſerv'd that light bodies, brought near any part of the fricated cylinder, would to appearance be equally attracted or gravitate, contriv'd a ſemi-circle of wire, which he could faſten at a determinate diſtance, environing the upper ſurface of the cylinder, at four or five inches diſtance from it; round this wire he twiſted ſome pack-thread, by which means he could with eaſe hang the threads at nearly pretty equal diſtances, the lower extremities of which reach'd within leſs than an inch of the cylinder, when directed towards its center, but when at liberty, they appeared as in Fig. 1. Plate II. And when the cylinder was turn'd round pretty ſwiftly, the threads would appear in the agitated

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agitated air, as in Fig. 2. but when he applied his hand on the lower part of the cylinder the threads would repreſent a form like Fig. 3. and from all parts ſeem to gravitate, and be attracted in a direct line towards the center of the moving body, ſuffering no inconvenience or diſorder of poſition from the wind cauſed by the rapidity of the motion; and by ſhifting the attrition, he could draw them in a line towards either extremity of the cylinder, yet ſtill pointing towards its axis; and when he revers'd the wire with the threads, that is, encompaſſed on the under part of the cylinder, as he had done before the upper, it anſwered exactly the ſame, all the threads pointing towards its axis, as in Fig. 4. He likewiſe gave a motion to the ſame cylinder in a perpendicular poſition, by which means he had the opportunity of placing a hoop-wire horizontally, with threads as before, leaving only one ſmall part expos'd between them for the touch of his fingers; yet the threads, upon his giving a motion and attrition to the cylinder, elevated themſelves from their hanging poſition, making an horizontal plane all round, and directing their looſe extremities to the axis of the cylinder, as in the former; now, how far this experiment may ſerve to explain the nature of electricity, magnetiſm or the gravitation of bodies, Mr. *Hauksbee* leaves others to determine.

An Account of a Storm *of* Rain *that fell at* Denbeigh *in* Wales. Phil. Tranſ. N° 308. p. 2342.

UPON *Tueſday* the 16th of *July* 1706, about 8 o'clock in the morning, it began to rain in and about *Denbligh*, and continued inceſſantly for 30 hours, but not very violently till about three or four o'clock on *Wedneſday* morning, when it rain'd ſomewhat faſter, attended with a terrible noiſe, like thunder, with ſome flaſhes of lightning, and a boiſterous wind; about break of day the rain and wind began gradually to abate every hour, till one or two o'clock in the afternoon, and then it perfectly ceas'd, and the air became clear and ſomewhat calm; on *Tueſday* the wind blew ſouth-weſt, but on *Wedneſday* it was come to the north-weſt; the effects of this great ſtorm were diſmal; for it cauſed the overflowing of all the rivers in *Denbeighſhire*, *Flintſhire* and *Merionethſhire*, &c. which ſpoil'd a great deal of corn, and carried off all the hay that was mow'd down, near the banks of the rivers in ſuch vaſt quantities, that it choaked the arches and inlets of the bridges, and broke down a dozen large ones; oaks and other large trees were rooted up and ſwept away, with ſeveral quick-ſet hedges, and

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and ſome quillets, by the ſide of the river *Elwy* were ſo cover'd with ſtones and gravel, that the owners could not well tell, whereabouts their hedges and land-marks ſtood, and this river altered its channel in ſome places; two or three rivulets, that conveyed water to ſome mills, were choaked up with ſtones and gravel: It was affirmed by ſeveral people, that the great floods were not ſo much the effects of the rain, as the breaking out of a vaſt number of ſprings in ſuch places, as they were never known to flow from before; in the town of *Denbeigh* a great many broke out in the houſes and ſtables, eſpecially, in that part next the caſtle, on the north-ſide; and ſome of them with a great deal of violence, and in ſuch quantities that it was averred by ſeveral men of the town, that three of theſe new ſprings, which flowed out of the ſtables of the *Bull*, *Croſs-keys*, and *Boar's-head* inns, were ſufficient to turn any corn-mill: At a ſmall diſtance northward of *Denbeigh*, lies *Park-ſnoding*, a rocky hill, where there broke out a great many ſprings, which flowed ſo plentifully for 9 or 10 days, that the cattle were watered in them for all that time; whereas, before and after, the people were obliged to water them all ſummer long at a well in the highway, at ſome diſtance from *Park-ſnoding*; there were ſeveral deep holes and trenches cut in the highways, adjoining the river *Elwy*, &c. and ſome of them very large; which was not attributed ſo much to the overflowing of the river, as to the breaking out of ſprings in thoſe very places: In *Comb* mountain there was a pit of a circular form, which in the ſummer time was wont to have little or no water in it, and in winter, as much water as would ſwell the ſurface to about 14 or 16 yards; but now in the middle of ſummer it roſe up at leaſt a yard and a half higher than it was ever known to have done in the wetteſt winters; and overflowing its banks, it fell down the hill with ſuch violence, as to penetrate into the very body of a rocky road and dug large pits into it, ſo that this common highway was become irreparable.

A Tumour *on the Neck full of* Hydatides; *by Mr.* Anthony Hewnden. Phil. Tranſ. N° 308. p. 2344.

A Gentlewoman in *London*, 25 years of age, had a large wenny tumour; the baſis, taking its origin from all the lower hinder part of the ſcull, extended down the neck near each jugular, and almoſt as low as both the *Scapulæ*; there was a *Phlegmon* on the upper parts; the *Radix* being ſo large, he applied a tranſverſe cauſtic the whole length and breadth of the tumour, intending to ſeparate the *Cutis* from the membrane of the *Cyſtis*; but it being

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ſo thin where the *Phlegmon* was, he was obliged to divide the *Cyſtis*; and out of it Mr. *Hewnden* extracted upwards of threeſcore *Hydatides*, of the bigneſs of a ſmall walnut, and ſeveral others were broken; theſe *Hydatides* ſwam in a liquor of the conſiſtence of the whites of eggs; in this *Cyſtis* he found a large quantity of an atheromatous and ſteatomatous matter, and at its baſis a large *Sarcoma*; he cut off the greateſt part, but apprehenſive of hurting the muſcles of the neck, he deferred it to the next dreſſing, intending to take away the reſt of the *Sarcoma*, and the *Radix* of the *Cyſtis* by cauſtics, which he applied without ſucceſs; for they came off without making an *Eſchar*, the *Radix* being of a cartilaginous ſubſtance; ſearching with his probe, in order to find ſome interſtice, he touched upon ſome membranous or nervous body, which cauſed the patient to ſcream out furiouſly; and into this interſtice Mr. *Hewnden* put a piece of *Roman* vitriol fitted to the place, which came out next day all diſſolved, together with ſome of the *Radix*; by the conſtant application of the vitriol, he extirpated the whole *Radix*, and healed the part S. A. It is obſervable, 1. That ſeven years before this operation, this tumour was very near as big as it was at this time, and ſubſided of itſelf. 2. That when Mr. *Hewnden* began with cauſtics, the firſt he uſed was *Præcip. Rub.* with which he covered the whole *Radix*, and it came off without any *Eſchar*, but it ſalivated the patient for five weeks.

An Account of a monſtrous Birth; *by Mr.* Robert Taylor. Phil. Tranſ. N° 308. p. 2345.

A Poor woman near *Hitchin* was delivered of twins conjoined together; they had but one trunk, with two necks, a head on each; four arms, two forwards and two backwards; thoſe backwards croſſed each others ſhoulders, like two perſons ſide to ſide; they had but one navel, two matrix's, two fundaments, two pair of hips and four legs; they had gone the full time, having hair on their heads, and nails on their fingers and toes; the midwife affirmed, they were alive within leſs than half an hour before they were delivered; they looked very clear and well; and by reaſon of their being conjoined, were about ſeven inches over.

Obſervations of a Comet *that appeared at* Rome; *by Mr.* John Ray. Phil. Tranſ. N° 309. p. 2350.

December 20th 1664 *N. S.* about three o'clock in the morning Mr. *Ray* obſerved the comet; it was in the conſtellation of *Hydra*, not far from the foot of *Crater*; it appeared about

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about the bigneſs of a ſtar of the firſt magnitude, but nothing near ſo lucid and bright; it had a very long tail, which pointed almoſt directly towards the heart of *Hydra*; the tail ſhewed ſomewhat like rays of a candle burning in a miſt; its figure was conical, its length five or ſix degrees; its breadth at the baſe not above one degree and a half; the body of this comet was about three degrees to the ſouth-eaſt of the moſt ſoutherly ſtar in the foot of *Crater*; it ſtood very nearly in the right line with the two lowermoſt ſtars in the foot of *Crater*, which are common to it and *Hydra*: *December* 21ſt in the morning about the ſame hour, it was removed weſtwards, and a little to the ſouth about one degree and half from the place where it ſtood; the tail ſtill pointed towards the heart of *Hydra*, and appeared at leaſt 10 degrees long: *December* 22d at the ſame time, it was removed from the place where it ſtood the day before to the ſame point, and about the ſame diſtance, as the preceeding night; its tail ſtill pointed to *Cor Hydræ*, or ſomewhat above it, as the two preceeding days; and was rather longer than ſhorter; it alſo appeared, as Mr. *Ray* imagined, brighter and larger, its body being bigger than any fixed ſtar, excepting *Sirius*: *December* 23d. it was removed to the ſame point, and about the ſame diſtance, as the day before; its tail was as long as ever, pointing almoſt directly to *Cor Hydræ*, and the comet itſelf was brighter: *December* 24, 25, 26th; all theſe nights were cloudy, ſo that he could make no obſervations: *December* 27th he found it ſtrangely removed from the place, where it had been; it was ſtill weſtward, and a little to the ſouth, as before; its body was ſtill brighter, being amongſt the ſtars of *Argo*, and its tail was larger and more buſhy, and yet as long as before; it pointed almoſt directly againſt *Canis major*: *December* 28th at the ſame time, it was removed above two degrees towards the ſame point, and was come within four or five degrees of the moſt eaſtern ſtars in the bright triangle in the buttock of *Canis major*; the moon happening then to ſhine, he could not ſo well judge, either of the bigneſs of the comet's body, or of the length and buſhineſs of the tail: *December* 29th it was ſtrangely removed, and got before, not only the eaſtern ſtar of the ſaid bright triangle, but alſo the moſt northern; Mr. *Ray* imagined, that in theſe laſt 24 hours, it moved at leaſt four degrees; the moon ſhining bright, the tail could not well be obſerved, yet ſtill it ſeemed to point directly to *Canis minor*.

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PLATE. II.

Fig. I.

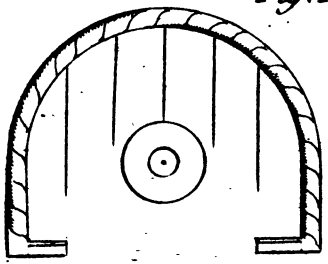


Fig. II.

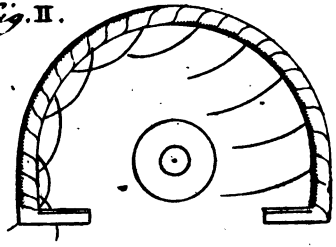


Fig. III.

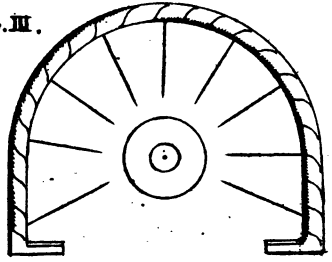


Fig. V.

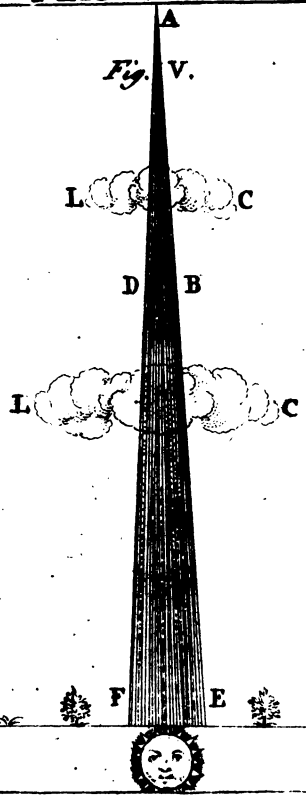
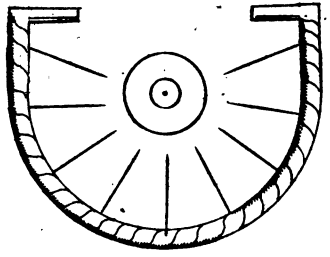


Fig. IV.



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G. Smith del.

Several Experiments, *ſhewing the ſtrange Effects of the* Effluvia *of* Glaſs, *produceable on its* Motion *and* Attrition; *by Mr.* Francis Hauksbee. Phil. Tranſ. N° 309. p. 2372.

EXperiment I. *containing farther obſervations on the attrition of glaſs.*

In the late experiments, which ſeem ſomewhat to illuſtrate attraction or electricity, by the extremities of the ſurrounding threads pointing to the axis of the fricated glaſs, there is ſomething farther very remarkable; *viz.* that after the attrition of the glaſs has been a little while continued, and the effluvia laid hold on the hairy or woolen threads (having uſed ſuch as is called *crewel*) that then, tho' the attrition had ceaſed, and the glaſs was without any motion, yet all the threads would retain their direction for four or five minutes, and ſometimes longer, before they could diſengage themſelves from the attracting or electrical effluvia; moreover, if one's finger, or any thing elſe be brought near the pointing extremities of the threads, whilſt the effluvia act with ſo much vigour, as to ſuſtain them directed, that then, they would avoid a touch from it, juſt as if the north pole of the magnet were applied towards the ſouth point of a needle; and at the ſame time, if the finger is held, at about an inch from the extremity of the aforeſaid thread, it will there ſeem to be attracted, and remove itſelf ſomewhat out of its direction to the approximated body; but if any thing is held between the glaſs and the directed thread, then the thread immediately loſes hold of the effluvia, and returns to its firſt poſition; yet, upon withdrawing the interpoſed body (if it has not removed itſelf too far out of the reach of the effluvia) it will again return to its tendency, and ſo continue, till its gravity is too great for the decayed vigour of the effluvia to maintain it in ſuch a direction; he afterwards tried the ſame experiment, with a globe-glaſs, which, when the attrition was made, would in all manner of poſitions, attract the ſurrounding threads, directing them towards its center.

Exp. II. *Shewing the direction of woolen threads every way from the axis, towards the circumference of a fricated glaſs.*

Mr. *Hauksbee*, in order to try what appearances might occur by placing the woolen threads on the axis within, as heretofore he had done on the outſide, and making the attrition on the external ſurface, as uſual, took a globe glaſs about ſix inches diameter, and having conveyed into its body ſome woolen threads tied to a ſtick, which was placed in it as an axis, and

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being fixed on the machine, the great wheel was turned, and the hand applied as usual; but he soon found the inconveniency of a glass of that figure, the threads entangling with each other, and no way to loosen or separate them; what was farther observable at that time, was, that upon bringing his hand near the glass, which was then at rest, he was surprised to see a motion of the bodies within side, and upon farther examination, he found that it was occasioned by the approach of his hand, since he could by a motion of his finger towards the point of any of the threads that did not touch the inside of the glass, drive it any way; it seemed to fly from his finger held on any side of it, and that without coming near the external surface by half an inch or better; this surprising phænomenon, tho' a body so solid as glass interposed, shews the subtilty of the effluvia, the body from which it is produced seeming to be no impediment to its motion; besides, it seemed very much to resemble or emulate a solid, since motion may be given to a body, by pushing the effluvia at some distance from it; but what is still more surprising is, that this body, tho' so subtile, as seemingly to perviate glass, will not, as has been before observed, affect a light body thro' a piece of muslin; now, whether the muslin absorbs the effluvia, or what other laws it may be subject to, Mr. *Hauksbee* cannot determine: Mr. *Hauksbee* tried the same experiment with a glass exhausted of its air, but it afforded nothing observable.

Exp. III. *Being a repetition and improvement of the former.*

Mr. *Hauksbee* procured a glass of a more suitable figure, for a repetition of the foregoing experiment, being almost an hemisphere with a neck to it, by which it was screwed to one extremity of a spindle, and had motion given it by the large wheel as usual; this manner of fixing, and the figure of the glass, gave him an opportunity of rubbing it, as well within as without, tho' upon trial he found, that either way was much the same; To proceed, when the threads were fixed on an axis within, and the motion and attrition made as usual, all the threads then pointed to the axis, and then whilst they retained that position, if a finger was brought near the outside of the glass, a motion would be given to the point of the thread that lay nearest it within side; and at the same time, if the threads were removed to the outside, and the finger held within, the like motion would be given them there; generally, the threads seemed to fly the approach of the finger; yet sometimes, Mr. *Hauksbee* had seen them jump suddenly towards it, when at more than an inch distance;

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ance: It is obſerv able, that the figures repreſented by the threads directed from, and towards the center, do not only emulate, but ſeem very much to reſemble the centripetal and centrifugal tendencies of bodies in their motions either way.

Exp. IV. *Shewing that the effluvia of glaſs, are capable of performing the office of attrition, cauſing a light by falling on an exhauſted glaſs in motion, as if rubbed by the hand.*

Mr. *Hauksbee* took a large globular glaſs, about nine inches diameter, which being exhauſted, he fixed to give it motion, by the machine deſcribed *Phil. Tranſ.* N° 304. its axis ſtanding perpendicular; another globular glaſs, about the bigneſs of the former, was placed to give motion to it by a new machine, and was wrought with its axis parallel to the horizon; this laſt, with its contents of common air, was fixed, ſo as to move within an inch of the other; in theſe poſitions the machines were ſet on work, and the naked hand was applied to the unexhauſted glaſs, the effluvia of which in a little time reaching the exhauſted glaſs in motion, immediately produced a light on that part of it neareſt the other, without the aſſiſtance of a touch from any thing elſe to influence it; this light was pretty ſtrong, and extended itſelf ſo far on the globe, as the effluvia could reach; it was not near ſo much of a purple colour, as when cauſed by the attrition of the hands; but, would remain, or live on the globe for half a minute or more, after the motion of the rubbed glaſs had ceaſed; but, if the fricated glaſs be kept in motion, and the other at reſt, the light inſtantly dies, yet recovers again upon the firſt motion given it; after this he took a long glaſs, which had lain by him exhauſted of air upwards of ſix months; this glaſs having been rubbed a little with his hand to evaporate the moiſture on its outſide, he held it over the unexhauſted glaſs in motion, which was at the ſame time rubbed by his hand; and it was very ſurpriſing to ſee, what large flaſhes of light would at intervals be produced in the long glaſs, without touching the glaſs in motion, tho' itſelf was neither moved nor influenced by any immediate attrition.

Balls *of* Hair *taken from the* Uterus *and* Ovaria *of ſeveral* Women; *by Mr.* James Yonge. Phil. Tranſ. N° 309. p. 2387.

MR. *Yonge* was called to deliver a woman 30 years of age, who was four days in labour of her firſt child; its head, being too big for the paſſage, ſtuck immoveable at the *Os Pubis*;

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ſo that he could neither faſten a crotchet, nor extract it by a cupping-glaſs fixed to the ſcalp with an air-pump; in this extremity Mr. *Tonge* directed his ſon to open the child's head, and take out all the brains, with ſo much of the ſcull as he could; and then by a cord faſtened round the neck with a nooſe, to pull it out, which was ſoon and eaſily done; the child was corrupted and ſtunk much, as alſo the *Lochia*, which flowed for three weeks; ſoon after they ceaſed, the *Menſes* appeared, and the woman went abroad; about ſix weeks after her delivery, ſhe was ſeiſed with violent convulſions, and hyſteric fits, which laſted near three days, when a painful tumour aroſe on the left ſide of her belly, which ended in an eruption of near a pint of white thick matter, with ſmall knobs of a ſubſtance like the yolk of boiled eggs; all ſymptoms immediately vaniſhed, only ſhe complained of the great hollowneſs, where the tumor had been; four days after this, the like ſwelling appeared on the right ſide of her belly, which continued with a ſmall flux of matter about five or ſix months, in deſpite of the ſeveral medicines uſed to cure her; about that time there appeared in the *Pudenda* a bunch of ſomething like greaſy wool, which being extracted, proved to be a ball, or wad of hair, being fine, ſoft, indifferently ſtrong, ſhort, of a light brown colour, and intangled like a parcel of combings, and as big as a turkey's egg, incloſed in a *Folliculus*, immerſed in an unctuous ſlime, adhering on one ſide to a membrane as large as the palm of a man's hand, and in the middle of it there was a ſmall pyramidal bone reſembling a ſplit tooth; the tumour ſunk upon this, and the fluor immediately ceaſed, and her *Menſes*, which had not appeared all this while, flowed as uſual, and ſhe continued in perfect health full nine months.

This caſe, tho' rare and extraordinary, has ſometimes happened to others: In Dr. *Hooke*'s *Phil. Collect.* N° 2. Dr. *Tyſon* tells us he diſſected a young gentlewoman, and found the right *Teſtes* or *Ovarium*, ſwollen into two bags, almoſt as big as a man's head, full of a pale *Serum*, in which floated ſeveral lumps of a ſoft fatty matter, which diſſolved in part, when put into hot water; one of theſe pieces were half as big as a man's fiſt, in which lay a great deal of hair (as there did, tho' not ſo plentifully, in all the reſt) of a ſilver colour, ſoft, fine, ſtrong, and above two foot long, it did not adhere to, nor did it ſeem to grow from any part, but lay intangled in this matter, and in it a bony ſubſtance exactly reſembling that, commonly called the eye or dog-tooth: Dr. *Tyſon*, diſſecting a woman 40 years of age, found

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found near the *Uterus*, a bag as big as a large turkey egg, and in it a fatty ſubſtance, like that above-mentioned, with a large quantity of light ſoft hair faſtened to a fleſhy ſubſtance; within this *Cyſtis* there was a bone, in ſome ſort reſembling a mandible, with ſeveral ſockets, and three *Dentes molares*, or grinders, and a fourth not quite grown out: Dr. *Grew* tells us, that there is ſuch another tooth in the *Muſæum* of the *Royal Society*, found in the ſame manner, by Dr. *Tyſon*, and the Dr. himſelf informs us, *ubi ſupra*, that Dr. *Needham* found a tooth, together with the hair in the *Ovarium* of a dead woman; and Dr. *Hook* ſays, that Dr. *Samſon* found the like in two large globular tumours, which were parts of the extended *Ovarium*, wrapt up in diſſolvable and inflammable fat, of a yellow colour: Sir *Andrew Leak* gave Mr. *Yonge* a ſmall bunch of hair, part of what was found in the belly of a young woman at *Deal*; the account of which is as follows:

A young woman of 30 years of age, fell into a periodical fever, and afterwards into a total ſuppreſſion of her *Menſes*, which was ſoon followed with a pain and tumour in the right ſide of her belly, which grew and increaſed maugre all the medicines adviſed by the neighbouring phyſicians, 'till it became bigger and harder than that of a woman in her laſt month; when it had grown a full year, it began to ſoften; at the end of 15 months, her belly was diſtended in ſuch a manner, that it ſeemed ready to burſt, which made the patient deſire the phyſicians to adviſe the ſurgeon to make the *Paracenteſis*; but all were ſurpriſed to find that inſtead of water, there ruſhed out a pint and half of ſweet well-digeſted matter; the following day the ſurgeon tapped as much more, and then he perceived hair four or five inches long iſſue forth with the matter, but ſo cloſely adhering to the inſide, that he could not pull them out without great pain to the patient; ſhe lived but four days after the operation; and opening her belly, there were found 10 quarts of the ſame matter, which flowed thro' the tap-hole, and a lump of hair floating therein, wrapt in a fatty matter, from which when it was ſeparated, it weighed full half an ounce; on the right ſide of the *Uterus* he found a protuberance bigger than a large walnut, from which the hair grew eight inches long; that tumour, or rather the *Ovarium* being ſeparated from the *Matrix*, there was found in it a compleat dog-tooth ſocketed in a bone of a triangular figure, in which another tooth was growing; the bone had a *Perioſteum* on it covered with fleſh, adhering at the *Calvaria* to the ſcull.

The

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The case of Mr. *Yonge*'s patient suggested two difficulties, which he could not get over; *viz.* 1. How these substances got thither? 2. And how they got out? And he doubts not but they were lodged in or near the *Testis*, the place of the tumour and pain, and the several anatomical discoveries made by those great philosophers above quoted, do even demonstrate it; they could not be conveyed into that bowel, and therefore, they must have been formed therein; but how, and of what materials, is the question? Such philosophers as call those extraordinary appearances *Lusus Naturæ*, seem like those of old, who tired in their natural researches by some puzzling difficulty, took refuge in words, ascribing the causes of things they could not account for, to occult qualities, *&c.* If they mean by *Lusus Naturæ* the sport or recreation of nature, they accuse her wrongfully, who does nothing in vain, and who is the author of all the order, beauty and advantages we enjoy, as delighting to make monstrous, deformed, useless, and mischievous things; things præternatural and contrary to nature, because, destroying its best work, *Man*; if by it they mean, that nature, in the work of generation, mistook, failed, or was disappointed; and instead of forming an *Embrio* or *Fœtus*, made a chaos, a confused lump of bone, fat, hair and membranes, the materials or elements of animal bodies, they greatly err; for, in all such acts of nature, the coition of both sexes is requisite, according to the old, or either of the new *Hypotheses de Generatione Animalium* which was wanting in the girl of *Deal*; she having been found, upon a very nice and strict scrutiny to die a virgin untouched.

We are told by several authors of the best credit, that large quantities of hair have been found in all the parts of the human body, the fluids not excepted; Dr. *Tyson* published a large collection from them; he reasons like a philosopher on the nature and production of hair on human bodies, living or dead, especially in those parts Mr. *Yonge* mentions; but the teeth and bones seem too hard, even for so acute an investigator; he has indeed given some very fine thoughts, and ingenious conjectures concerning their origin, and production; this is the only difficulty, all those accounts Mr. *Yonge* has taken from others are incumbred with; but Mr. *Yonge*'s case has another no less hard to resolve; it is obvious how those things were got out of the women that died; but his patient who survived the evacuation, puzzled him, to find the *Ductus*, for such a lump to pass from without the *Uterus* into the *Vulva*; it was certainly lodged without the *Uterus*; but which way such a lump of greasy hair, with a bone, and a large membrane adhering thereto,

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thereto, could pass into it? He knows none but the *Tuba Fallopiana*; but the orifice of that into the *Uterus* is so small, that it sometimes will not admit an *Ovum*, no bigger than a pepper-corn to pass; whence those conceptions, which are made in that trunk, are occasioned; it will distend very largely, so as to contain a big *Fœtus*; but where it is inserted into the *Matrix*, the *Foramen* is too narrow for substances of such magnitude to pass, unless some very extraordinary accident expand it, and what that may be Mr. *Yonge* cannot apprehend.

A Lunar Eclipse, *observed at* Zurich *the* 17*th of* April, 1707; *by Dr.* John James *and* John Scheuchzers. Phil. Trans. N° 310. p. 2394. *Translated from the* Latin.

H		M	S	
12	9	to 18		The *Penumbra* on *Maræotis*.
		18	40	The true shadow within the disk of the moon.
		20	15	*Palus Maræotis* in the shadow.
		23		The beginning of *Mare Eoum*.
		25	20	*Mons Alabastrinus*; the middle of *Mare Eoum*.
		27	40	the beginning of *Sinus Sirbonius*.
		29		the middle of *Sinus Sirbonius* and *Mare Egyptiacum*.
		29	20	the beginning of *Insula Cercinna*.
		29	30	*Lacus Meridionalis*.
		30	30	the middle of *Cercinna*.
		31	40	the end of *Cercinna*.
		33		the extreme prominence of *Mons Sopher*.
		34		the islands between *Sicilia* and *Cercinna*.
		35		the beginning of *Mauritania* and *Sinus Hyperboreus*.
		36	40	the middle of *Sinus Hyperboreus*.
		37	20	*Mare Pamphilium*.
		37	30	*Creta*.
		37	40	the beginning of *Ætna*.
		38	40	the middle of *Ætna*, *Melos*, *Carpathos*.
		39	30	the end of *Ætna*.
		41		*Rhodus*.
		43	40	the beginning of *Sinai*.
		45		the middle of *Mare Adriaticum* and *Sinai*.
		45	20	the end of *Sinai*.
		46	30	the middle of *Mare Adriaticum*.

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H	M	S	
	48	40	the beginning of *Propontis* and *Mare Hyperboreum.*
	51	30	the middle of *Propontis* and end of *Mare Adriaticum.*
	52	40	the beginning of *Lacus niger major.*
	53	10	*Lacus Thraſumenus.*
	53	30	the middle of *Lacus niger minor.*
	54	30	the beginning of *Inſula Besbycus.*
	55	10	the beginning of *Pontus Euxinus in Sinus Salmydeſſus.*
	56		the end of *Propontis.*
	57	30	the beginning of *Pontus Euxinus inferior.*
	58		the beginning of *Byzantium.*
	59	10	the end of *Byzantium.*
	59	40	*Promontorium Acheruſium.*
1	1		the beginning of *Boriſthenes*; *Apollonia.*
	1	30	the middle of *Pontus Euxinus.*
	3	20	the middle of *Sinus Athenienſis.*
	4	40	*Palus Byces.*
	5	40	*Promontorium Heracleum.*
	7	40	the middle of *Cochilis*; ending at *Sinus extremus Ponti.*
	8	30	the middle of *Lacus Corocondæ.*
	9	20	*Promontorium Herculeum* and beginning of *Mare Caſpium.*
	11	40	the beginning of *Palus Amodocæ.*
	16	20	the middle of *Palus Amodocæ.*
	18	10	the end of *Palus Amodocæ.*
	20		*Paludes amare & Lacus minor.*
	20	40	*Lacus major.*
	22	10	a very ſlender lucid margin.
	23	20	the whole body of the moon in the ſhadow.
	24	40	almoſt the entire diſk of the moon, excepting *Mare Mediterraneum*, ſhone with a diluted brightneſs, ſo as that the ſeas could be diſtinguiſhed thro' the teleſcope.
	40		no ſpot beſides the *Palus Mæotis*, could be diſtinguiſhed thro' the teleſcope.
	45		the middle of the moon's diſk is darkened more and more, its periphery continuing clearer.

H. M.

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H	M	S	
2	12		the disk of the moon appeared to the naked eye of a ruddy colour, and no spot could be distinguished thro' the telescope.
	15		the whole disk darkened more and more, its periphery continuing somewhat bright.
	28		the disk clearer oppofite to *Palus Maræotis*, and the shadow very thick towards *Palus Mæotis*.
	33		the whole disk becomes gradually clearer, whilst a greater darkness covers *Palus Mæotis* and the places near it.
	51	40	the seas appear gradually.
	56	30	the *Pontus Euxinus* and *Mare Caspium* in the middle of the obscuration are covered as it were, with a thick cloud.
3		5	*Mare Eoum*, and the places near it could be distinguished, tho' the moon had not yet emerged from the shadow.
	9	40	the true beginning of the emersion.
	11	30	*Palus Maræotis* begins to emerge.
	13		emerged.
	15	40	*Mare Eoum* begins.
	21	30	*Sinus Sirbonius & Mare Egyptium* emerged.
	26		*Regio Cassiotis* emerged, and *Insula Cercinna* emerged some minutes before.
	27	40	*Mons Athos* and *Malta* emerged.
	31		*Mauritania* emerged.
	38		*Corsica* and *Sicilia* emerged.
	45	20	the middle of *Propontis* emerged.
	49		*Besbicus* emerged.
	52		*Byzanztium* emerged.
	57	30	*Promontorium Acherusium* emerged.
4	5	20	*Pontus Euxinus* and the middle of *Mare Caspium* emerged.
	6		*Palus Mæotis* begins.
	9		*Mare Caspium* and the middle of *Meotis* emerged.
	11	20	*Mæotis* emerged.
	13	40	the *Penumbra*.
	14	20	the moon entirely emerged. In the emersion the shadow seemed to be more distinct, than it was in the immersion.

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12	18	40	the beginning of the eclipſe in the true ſhadow.
1	23	20	the greateſt obſcuration.
3	9	40	the beginning of the emerſion.
1	46	30	the duration of the total obſcuration.
4	14	20	the end of the emerſion.
3	55	50	the total duration.
1	5	40	from the beginning to the total immerſion of the moon
1	5	40	from the emerſion to the end of the total eclipſe.

An Eſſay *on the* Invention *of* Printing; *by Mr.* John Bagford. Phil. Tranſ. N° 310. p. 2397.

IT is the general notion of moſt authors, that we had the firſt hint of printing from the *Chineſe*; but Mr. *Bagford* is far from being of that opinion; for at the time of the diſcovery we had no knowledge of them; he rather ſuppoſes we may more probably have taken it from the ancient *Romans*; as from their medals, ſeals, and from the marks or names at the bottom of their ſacrificing pots; but if it be certain, that cards are as old as our King *Henry* the VIth, nothing as Mr. *Bagford* thinks, ſeems to give ſo fair a hint for printing, as the making of cards; as is evident by the firſt ſpecimen of printing at *Harlem*, and by ſome books in the *Bodleian* library at *Oxford*; one in *Junius*'s collection, another in archbiſhop *Laud*'s, and a third in the ſame collection, being the lives of the *Ruſſian* ſaints in a thin folio; the leaves are not paſted together, as the former two are, but cut on wooden blocks, and illuminated; there is alſo another rare ſpecimen of the firſt, in that valuable collection of archbiſhop *Parker* in *Bennet College* library, at *Cambridge*, bound up with a M. S. book, this differs very much from thoſe at *Oxford*; it is the life of *Chriſt* in figures, or rather the types of the old and new teſtament; they have not ſo many ſpecimens of the firſt printing at *Harlem*, as we have in *England:* The cutting of the blocks or moulds for making our playing-cards, is in the ſame manner, as thoſe for the books printed at *Harlem*; they lay a ſheet of moiſt or wet paper on the form or block, after firſt lightly bruſhing it over with ink, made of lamp-black mixed with ſtarch and water, then they rub it off with a round liſt, with their hand, which is done with great expedition; this is for the picture or court-cards; then they paſte them together threefold, the coarſeſt being put in the middle; they are coloured by the help of ſeveral patterns, or ſtanefiles, as they are called, which is card-paper cut thro' with a penknife, for each colour, as red, *&c.* for at the firſt printing, the card has only

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only a meer out-line: These patterns are painted with oil-colours, to preserve them from wearing out with the brushes; they lay the pattern upon the picture, and by sliding a brush, that is full and loose, gently over it, it fixes the colour into the cut holes, and leaves it on the print, that is to be a card, and so on for all the other colours that are to be seen on cards; all which is better understood by seeing them perform it, than by any description: This Mr. *Bagford* supposes to have been their first way of printing at *Harlem*. The hint might also have been taken from MSS 900 years old; for in them the great letters are done by the illuminators, in the same manner as card-making: The next method of printing at *Harlem*, was by cutting whole forms in wood, from MSS, and without pictures; such Mr. *Bagford* takes the *Donatus* to be, mentioned in histories; and this might bear date in 1450, and some say in 1440; and this may be as plainly demonstrated as the former, from copy-books, printed at *Rome*, *Venice*, in *Switzerland* and *England*, as high as 1500; this method of writing is harder to perform than either *Roman*, *Italic*, or any other letters used in printed books: The third method of printing was with single types in wood; but the author of this invention is unknown; it was then esteemed so uncommon a thing, that printers carried their letters in bags at their backs, and got money at gentlemen's houses, by printing the names of the family, epitaphs, songs, and other small performances: The fourth improvement of this noble art was the invention of single types in metal; here we must entirely ascribe the honour to *Peter Scheffer*, of *Grenschen*, servant and afterwards son-in-law to *Faust*, who entertained him to work in his house at *Mentz*; and he observing, how industrious his master was to improve this art, undertook it himself, and with much application and industry brought it to perfection; after he had made several essays, he at last discovered it to his master *Faust*, who making some experiments with his single types, and finding, that they would answer his expectation, was so transported with joy, that he promised him his daughter in marriage; which sometime after he performed, and they continued together improving this art with great secrecy, till it became known, and spread itself over all *Europe*; sometimes you have their names at the end of the books they printed, and sometimes not; sometimes with dates as high as 1457; as the psalms printed by them, now in the emperor's library, and mentioned by *Lambecius* in his *Bibliotheca*; and as low as 1490, for which we have the authority of *Erasmus*, in a preface to *Livy*, printed at *Basil*, by *Froben* A. D. 15.. As for *John Guttenburgh*, tho' he is said by several

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authors to be the first inventor of printing, yet we cannot find one book with his name and of his printing: We may rationally conjecture, that printing with plates of pewter, brass, or iron, either graved or etched, was first practised by the working goldsmiths; for they have a way of taking off the impressions of their work, by the smoke of a lamp, which perhaps, gave the hint to the graving on brass; and of this we have a dark account in authors.

The first printing at *Harlem*, was a book with pictures; they took off the impression with a list coiled up, as the card-makers use to this day; but when they came to use single types, they employed stronger paper, with vellum and parchment; then they made use of a press, tho' they afterwards contrived, and made it more serviceable; nor was their ink for printing brought to perfection at first, but improved by degrees; rolling-press printing was not used in *England*, 'till King *James* the 1st, and then it was brought from *Antwerp*, by our industrious *John Speed*.

Mr. *Bagford* saw at *Leyden*, over a glazier's door in the *Harlemer-street* (so called, because it leads to *Harlem*) the effigies of *Coster* cut in wood, and painted with an inscription; this statue was set up by a private person, the owner of the house, perhaps, for the name and sake of the street, and Mr. *Bagford* supposes, not older than about 1630; this statue is done after the graved print in the book at *Harlem*, or the painting over the door of *Laurence Johnson Coster*, where they say, he first practised the art of printing; but Mr. *Bagford* rather takes it, that he lived in this house in his old age, and was church-keeper or sexton; for so the word signifies, both in the high and low *Dutch*: Mr. *Bagford* went to *Harlem* to compare and collate one of the same impression in quarto, which Mr. *Bullard* had procured for him, with that at *Harlem*, the title of the book at the latter end runs thus, *this book was finished in the good city of* Culenburgh, *by me* John Valdener, *in the year of our Lord* 1483, *on the* Saturday *after St.* Matthew's *Day*; with the device of the printer hanging on the bough or snag of a tree, a custom they much used in those days, as may be seen by ancient monuments on grave-stones, not only in the great church at *Harlem*, but also in several other cities of *Holland*; the title of the book is in *Low Dutch* (the language in which it is printed) *viz.*

De Spiegel onser Behoudinge.

i. e. *The Mirror of our Salvation.*

On

On the cheſt, wherein this book was kept at *Harlem*, in the prince's garden, the date 1618, was inlaid in the wood; and upon collating it with the other he brought from *Amſterdam*, he found them to agree both in the words of the text, and likewiſe in the pictures; they only differed in this, that the *Harlem* book was in folio, with two pictures in each page, and the words column wiſe, and 25 lines in a column, containing 60 pages, and printed but on one ſide, and not paſted together, as thoſe at *Oxford* and *Cambridge*: At the entrance into the princes's garden, at the upper end of the ſummer-houſe, on the right hand, was *Coſter*'s ſtatue, leaning with its left hand on the inſcription, which bore date 1440; and in its right hand the letter A in a ſquare, with other figures, as little naked boys, and in their hands A B C, with the picture of *Fame*, holding the letters C D and E, which was taken from *Junius* in his hiſtory of the *Low Countries*; all theſe pictures with the ſtatue of *Coſter*, are painted on the walls of the ſummer-houſe, in diſtemper or water colours, and no older (as appears by the date on the cieling) than 1655.

Now as printing is but another way of writing, and brought to perfection by degrees, as other arts; and as pictures either painted, cut in wood, or graved, were called the laymen's books; for every one could read a picture, and ſay, *this is a houſe*, and *that a tree*; ſo Mr. *Bagford* ſuppoſes, that the pictures or drawings of the ancients gave the firſt hint of printing, and if the ſcribes had not, in proceſs of time, brought their art of writing into a decorum, uniformity, and rule in their ſeveral volumes, the printers could not have followed them ſo exactly in the imitation of their letters and the pages of their books; then the making of cards was another introduction to the invention of printing, which laſt he takes to be very ancient; the firſt ſpecimen of printing, was on one ſide only, as that at *Bennet* college, moſtly in figures, with ſome few words only on the ſide in labels, like that at *Oxford*; the next ſtep was that book at *Harlem*, were the deſigns of the prints are better executed; and then they came to have not only lines, but whole pages of words, beſides the pictures on a page; the next ſtep was ballad-printing, with the like pictures, and that only on one ſide; the next improvement of this noble art, was the cutting of whole pages on wooden blocks or moulds, and printing on both ſides of the page; and the firſt ſpecimen of this nature was, as ſome authors ſay, a *Donatus*, printed at *Harlem* and at *Mentz*, tho' others affirm, that a bible was printed in the ſame manner, in 1457.

A Pyra-

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A Pyramidal appearance in the Heavens, *obſerved near* Upminſter *in* Eſſex; *by Mr.* Derham. Phil. Tranſ. N° 310. p. 2411.

ON the afternoon of *Thurſday April* 3d, 1707, Mr. *Derham* obſerved in the weſtern part of the heavens, about a quarter of an hour after ſun-ſet, a long ſlender pyramidal appearance, perpendicular to the horizon; the baſe of this pyramid he judged to be the ſun, then below the horizon; its *Apex* reached 15 or 20 degrees above the horizon; it was throughout of a ruſty red colour, and when he firſt ſaw it, pretty vivid and ſtrong; but the top was much fainter than the bottom part, nearer the horizon; at what time this appearance began, whether at, or how ſoon after ſun-ſet, Mr. *Derham* could not ſay; but a while after he had perceived it, it became by degrees weaker and weaker, ſo that in about a quarter of an hour after he firſt ſaw it, the top-part *a* B D in Plate II. Fig. 5. was ſcarcely viſible; but the lower part continued vivid much longer, tho' it became by degrees ſhorter and ſhorter; he ſaw the remains of the lower half B D *qf* a full hour after ſun-ſet, and he thinks he could have ſeen it longer, had the horizon been open, his ſight being often obſtructed by trees, ſo that he was not only hindered from an accurate obſervation of the end of this unuſual appearance, but likewiſe of all the particulars, that might probably occur: The whole atmoſphere ſeemed hazy, and full of vapours, eſpecially towards ſun-ſet; the moon and ſtars were bearded at that time, and a halo appeared afterwards about the moon; and this diſpoſition of the air was probably, the cauſe of the phænomenon; the pyramid was, undoubtedly, imprinted upon the diſtant vapours of the atmoſphere, it being manifeſtly further off, or lying beyond ſome ſmall thin clouds, C L, C L, that intercepted it, and in thoſe parts covered and hid it: Mr. *Derham* never in his life ſaw any thing like it, excepting the white pyramidal glade, which is now called *Aurora borealis*; and the above-mentioned pyramid being (excepting in colour and length) ſo very like it, he ſuppoſes, that it may perhaps in ſome meaſure, conduce to the ſolution of that odd phænomenon, the *Aurora borealis*.

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Fig. I.

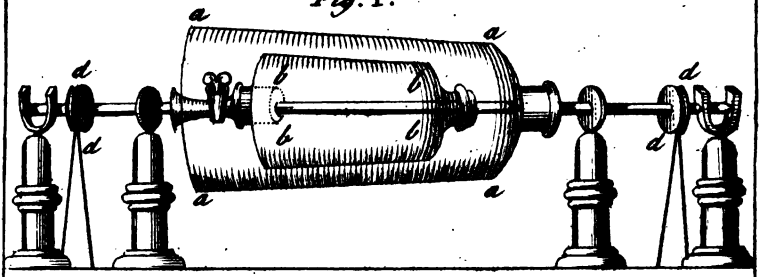
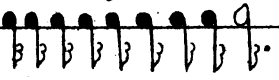


Fig. II.

Fig. III.



West

Fig. IV.

Upminster.

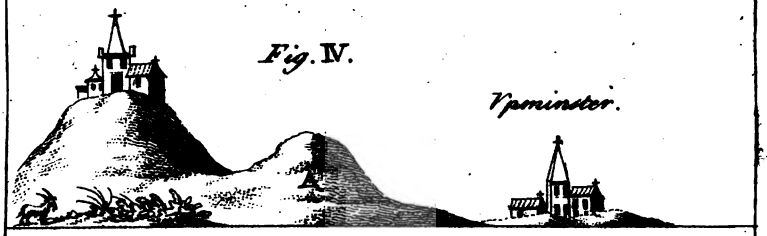


Fig. V.

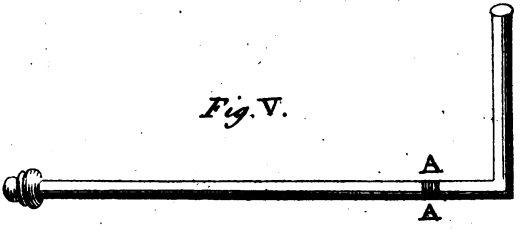


Fig. VI.

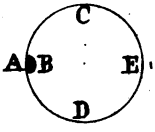
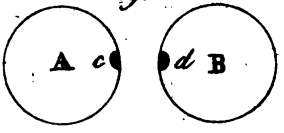


Fig. VII.



G. Smith del. Walcott Sculp.

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An Experiment, *confirming the production of* Light, *by the Effluvia of one* Glaſs, *falling on another in* Motion; *by Mr.* Francis Hauksbee. Phil. Tranſ. N° 310. p. 2413.

MR. *Hauksbee* took a large receiver, as repreſented in Plate III. Fig. 1. *aaaa*, within whoſe body he fixed another, as *bbbb*, both their axis lying parallel to the horizon, and they were fixed within each other at *c c*, the outward ſurface of the inner glaſs was at leaſt an inch diſtant from the inner ſurface of the outward one, and they were turned by two large wheels, whoſe bands communicated with the ſmall wheels *dddd* fixed on their axis; the inner glaſs was firſt exhauſted of its air, and being then fixed, as above-mentioned, he moved only that wheel, which gave motion to the large glaſs; ſuppoſing, that when the effluvia of that glaſs, by the application of his hand to it, would reach the other, tho' at reſt, it would nevertheleſs be affected thereby and give a light, which accordingly happened, ſpreading itſelf in flying branches all over; then turning the other wheel, the light became more conſiderable, and the greateſt that had been produced in any experiment made on that ſubject, and Mr. *Hauksbee* doubted not, but that it would have been more ſo, had the inward glaſs been fitted nearly to touch the inward ſurface of the outward one, the effluvia of which, as he ſuppoſes, would then be capable of acting with more vigour on the exhauſted moving receiver: But to return, he cauſed both the large wheels to give motion to the glaſſes one and the ſame way, with as equal a velocity as they could; yet he did not find, but the light was then as ſtrong, and continued as long, as when their motions were made reverſe; ſo that he did not perceive, that contrary motions any way contributed to the phænomenon; but motion without being preſcribed by rules (as this experiment ſeems to inſinuate) is found abſolutely neceſſary, and as indeed, the whole courſe of experiments on this head abundantly confirm: Mr. *Hauksbee* farther obſerved, that notwithſtanding the effluvia ſeemed to be equally diſtributed on the outer ſurface of the inner moving glaſs; yet the light was moſt vigorouſly apparent on that ſide of it next the attrition; and when the motion either of the outer, or inner glaſs ceaſed, ſuppoſing the other in motion (for upon trial, he found very little difference either way) the light would continue to appear a conſiderable time within the exhauſted glaſs, till the effluvia of the other could no longer act with ſo much vigour, as to affect the inner glaſs; he likewiſe obſerved, after both glaſſes had been for ſome time in motion,

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tion, the hand being applied all the while on the outer one, that then the motions ceasing, and no light appearing, it was but bringing his hand near the surface of the outer glass, to produce flashes of light like lightning in the inner glass, the effluvia then seeming to be more vigorously pushed upon it by the approach of the hand; he farther observed, that upon admitting a little air, the appearance of the light died, nor could it then be by any means recovered.

An Experiment, *shewing the difficulty of separating two* Hemispheres, *upon injecting an* Atmosphere *of* Air *on their external surfaces, without exhausting the included* Air; *by the Same.* Phil. Trans. N° 310. p. 2415.

THO' the pressure of the air be evident from a number of undeniable experiments made by the air-pump, yet to put the matter of fact past all dispute, Mr. *Hawksbee* devised the following experiment; he took a strong glass receiver, open and armed with brass-hoops at top and bottom, to which were applied two brass-plates with wet leathers between them; but first were included two brass hemi-spheres, which joined on a piece of wet leather, their diameter was three inches and a half; a mercurial gage was also included; to the upper hemi-sphere a large brass wire was screwed, which passed thro' a box of leathers screwed on the upper plate, and could easily be moved up and down, without suffering any air to pass with it; to the upper part of this slip-wire was screwed a cork, thro' which the air was to be injected; in this manner the lower and upper plates were strongly screwed to the receiver, into which, after an atmosphere of air had been injected (which was easily discoverable by the gage, the air therein possessing but half the space it did before) the syringe was taken off, and in its stead an iron with an eye was screwed on, by which the whole *Apparatus* was suspended on a triangle; then there was put into the scale, which hung at its bottom, so much weight as amounted to full 140 pounds, before the hemi-spheres could be parted; the friction of the slip-wire thro' the box of leathers was very considerable.

He afterwards repeated the same experiment with the like success; and in order to try how it would answer all manner of ways, he exhausted the same two hemi-spheres of their air, and then he found that the like weight was required for their separation, as when the additional atmosphere of air was thrown on their external surfaces, without exhausting the included air; and farther to confirm the same, he not only exhausted the included air

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air from the two hemiſpheres, but afterwards including them in the receiver, he likewiſe injected the ſame quantity of air on their external ſurfaces, as in the former experiment, and then he found, that 280 pounds (which was double the weight before required) did not ſeparate them.

Some natural Obſervations *in the* Pariſhes *of* Kinnardſey *and* Donnington *in* Shropſhire; *by Mr.* George Plaxton. Phil. Tranſ. N° 310. p. 2418.

MR. *Plaxton* at his induction (in *November* 6th, 1673) into the parſonage of *Kinnardſey*, where he had been incumbent for upwards of 30 years, found a great many aged people in the pariſh, and upon taking the number of the inhabitants, he obſerved, that every ſixth ſoul was 60 years of age and upwards, that ſome were 85 and others 90; this ſeemed ſurpriſing to him, the town being ſurrounded with a large moraſs, overflowed in winter, and no coming into the pariſh any way, upon arable land; at his entrance, he found neither gentleman nor beggar, nor any diſſenter from the eſtabliſhed church; and no law-ſuit had been known amongſt them in the memory of man, nor was there any commenced, during his incumbency as Rector there; the moraſſes or moors are of a large extent, and the pariſh is ſurrounded with them, for which reaſon, the village was called *Kinnardſey* or *Kinnardus* his iſland; *e i*, *e a*, *e y* are all watry terminations; thus the next pariſh is called *Eyton*, *i. e.* the town upon the waters; *Edney*, or *Edwyney*, *Edwin's* iſland; *Buttery* or *Butterey*, the iſland of *Butter*, being a large grazing tract of land, with ſome others of the like termination; all that vaſt moraſs was called the *Weald-moor*, or the *Wild-moor*, that is the woody moor; thus the wood lands of *Kent* are called the *Wealds* of *Kent*; the *Wolds* of *Yorkſhire* have, very probably been formerly woody and called the *Wealds*, for *Weald* or *Wold* is by our *Saxon* antiquaries rendered woody; and Mr. *Plaxton* was aſſured by aged people, that all the wild moors had formerly been ſo far overgrown with elders, willows, ſalleys, thorns, *&c.* that the inhabitants commonly hung bells about the necks of their cattle, that they might the more eaſily find them; theſe moors ſeem to be nothing elſe, but a compoſition of ſuch ſludge and refuſe, as the floods left upon the ſurface of the ground, when they drained away, and yet this dirt is full three or four foot thick; for he often obſerved, that the black ſoil caſt up by moles, or dug out of ditches, was a mere compoſition of

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roots, leaves, fibres, ſpray of wood, ſuch as the water had brought and left behind it; the inhabitants in digging, do often find roots and ſtumps of oaks three or four foot under the ſurface, and they are very common in the bottom of their ditches and drains; the ſoil is peaty, and cut up for fuel in ſome part of the Lordſhip; in the bottom of theſe peat-pits, are found clay, ſand, and other ſorts of ſoil; theſe grounds have formerly been much higher; for Mr. *Plaxton* obſerved oaks and other trees, where the preſent ſoil is ſo much ſhrunk and ſettled below them, that they ſtand high, and are ſupported by the large fibres of the roots, ſo that ſheep may eaſily creep under them: The large tract, formerly called *Vaſta regalis*, is by draining become good paſture land; it yields conſiderable quantities of hay, tho' a great deal of it be of ſuch a nature, as to dry up a new milk-cow, ſtarve a horſe, and yet feed an ox ſurpriſingly, nay, make him fatter than the beſt upland hay; this Mr. *Plaxton* ſuppoſes to proceed from its dry and binding quality, which makes the oxen drink much.

About half a mile from the pariſh church, is a pretty farm called the *Wall*, which Mr. *Plaxton* ſuppoſes to have been formerly a *Britiſh* fortification; it is encompaſſed with a moraſs, and raiſed up to a great height with ſand, broken ſtones, gravel and rubbiſh, and is (as he meaſured it) above 1900 yards in compaſs, and 16, 18, and 20 yards in breadth; in ſome places it ſeems to have been built, before the moors became boggy; for he could never find any way over the moors, by which they could have convey'd thoſe vaſt quantities of earth, clay, ſand, and rubbiſh to raiſe that extraordinary rampart: From the days of *Henry* the VIIIth Mr. *Plaxton* was the ſixth Rector in this pariſh.

In his Rectory of *Donnington*, to which he was preſented *Anno* 1690, he found as many old people, as he did in *Kinnardſey*, nay more; at *Kinnardſey* there were 135 ſouls, at *Donnington* 138; of the 135 he had 23 aged 60 and upwards, of the 138, he had 24 of that age, both which numbers multiplied by 6, the one at *Kinnardſey* was 138, the other at *Donnington* would have been 144; there is nothing remarkable in the pariſh of *Donnington*, excepting the *Royal Oak*, which ſtood at *Boſcobel*, and was ſurrounded with a great many more; this oak was a fair, ſpreading, and thriving tree, its boughs were all lined and covered with ivy; here in the thickeſt part of theſe boughs the king ſat in the day time with Colonel *Carlos*, and at night lodged at *Boſcobel-houſe*; the remains of the *Royal Oak* were fenced

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fenced in by *Basil Fitz-Herbert*, Esq; with a handsome brick-wall, with this inscription over the gate, in golden letters, upon a blue stone.

Felicissimam arborem, quam in Asylum
Potentissimi Regis Caroli *Secundi*, Deus *Opt. Max.*
per quem Reges regnant, hic crescere
voluit, tam in perpetuam rei tantæ
Memoriam, quam in Specimen firmæ
in Reges fidei, muro cinctam
Posteris commendant, Bazillius
& Jana Fitz-Herbert.
Quercus amica Jovi,

The XLVIth medal in Mr. *Evelyn's Numismata*, is what king *Charles* the I. caused to be stamped in honour of the installation of his son; on which is the *Royal Oak* under a princes coronet, overspreading subnascent trees and young suckers, with this inscription;

SERIS FACTURA NEPOTIBUS UMBRAM.

On the reverse, within the garter of the order, is this legend,

CAROL. M. B. REGIS. FILIUS CAROL. PRINC. INAUGURATUR. XXII MAII. MDCXXXIIX.

The following is an inscription on a pillar erected by the sea-side, where the king first landed.

Siste, Viator, iter, vestigia prima secundus
posuit hic Carolus, quum rêdit exilio.

The people in *Donnington* live to a great age; in one house Mr. *Plaxton* saw three healthful persons; *viz.* the husband, his wife, and the wife's brother, whose ages reckoned together made 278, and they lived some years after; Mr. *Plaxton* was Rector there about 13 years and some months; and in all that time he buried only 27 persons, four of which came from neighbouring parishes, four were young children, and of the remaining 19, the youngest was about 60, and the oldest 96 years of age; he was the fourth legal incumbent in succession from the reformation; and at one triennial visitation of the bishop, there was

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neither burial nor wedding to return into the regiſtry at *Lichfield*; the country is very healthful in thoſe parts, and tho' it ſeems to the eye of a traveller to be but of a moderate height, yet between *Donnington* and *Wolver-hampton*, which is but five miles, you croſs four brooks in the compaſs of three miles, two of which run into the *Severn*, into the ſouth-weſt ſeas, and the other two into the *Trent* and *Humber*, into the northern ocean.

An Account of the Cape *of* Good Hope; *by Mr.* John Maxwel. Phil. Tranſ. N° 310. p. 2423.

THE *Cape* of *Good Hope*, which is part of *Monomotapa*, and the ſouthermoſt part of *Africa*, lies in the latitude of 34 degrees 30 minutes ſouth, and 16 degrees 15 minutes eaſt of *London*; it was firſt diſcovered by *Bartholomew Diaz* A. D. 1495, under *John* II. king of *Portugal*; he gave it the name of the *Cape* of *Tempeſts*, becauſe of the ſtorms he met with there, and a ſea that runs very high, and makes it bad riding at anchor, when the wind is at north-weſt, ſince it is a neck of land ſtretching out into a vaſt ocean on each ſide; but king *John* gave it the name of *Bona Eſperança*, or *Good Hope*, which it ſtill retains; becauſe when that *Cape* was doubled, he had good hopes of finding out a way by ſea to the *Eaſt-Indies*, about which he was then very ſollicitous. The *Hottentots*, natives of this place, are a race of men diſtinct both from *Negroes* and *European Whites*; for their hair is woolly, ſhort and frizzled; their noſes flat, and lips thick; but their ſkin is naturally as white as ours, as appeared by a *Hottentot* child brought up by the *Dutch* in their fort here; their ſtature is univerſally of a middle ſize; they are clean limbed, well proportioned, and very nimble; Mr. *Maxwell* never ſaw a fat perſon among them; they beſmear their faces and bodies all over with ſuet, or other oleaginous matter, which together with expoſing their bodies to a warm ſun, makes their ſkin of a tawny colour, and ſtink in ſuch a manner, as to be ſmelt at a conſiderable diſtance to the windward; they adorn their hair (which is always clotted with greaſe and naſtineſs, like the thrums of a mop) with ſhells, pieces of copper, *&c.* both ſexes are commonly clad with the ſkin of a ſheep, but ſometimes of ſuch wild beaſts, as they happen to kill, with the hairy ſide outwards in ſummer, and inwards in winter, from which he has ſeen them pick, and eat the lice in the ſtreets; the women wear thongs of ſkins, ſeveral yards long, about their legs, which when dry, with the inſide out, do ſo much reſemble ſheep's guts, that moſt ſtrangers miſtake them for ſuch; the men hang

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hang their privities in a bag, and the women cover theirs with a flap or apron made of skins; the women also wear a cap of skins, only dried and stitched together, whereas, the men commonly go bare-headed; they also go bare-footed, only when they travel, they wear a piece of skin fastened about their feet; their weapons are javelins, with which they are very dexterous at hitting the mark, and bows with poisoned arrows, which kill, as Mr. *Maxwel* was told, upon drawing blood, but what they are envenomed with he could not learn; their houses are hemi-spherical, made of mats, supported by stakes, and so low, that a tall man cannot stand upright in one of them; these they remove upon occasion, as the ancien *Nomades* did their tents: Mr. *Maxwel* takes them to be the most lazy, and ignorant part of mankind; no arts are practised among them, no ploughing or sowing, no going to sea, not in so much as a boat, no use of iron or money, no notion of a God, a providence, or a future state; no tradition of the Creation, or the flood, no prayers, nor sacrifices, no magical rites; nor in fine (upon the strictest enquiry he could make) the least notion of any invisible being, capable of doing them either good or harm; so that Mr. *Maxwel* believes, their ignorance can hardly be parallel'd; the only thing that looks like religion among them, so far as he could learn, is a custom they have in moon-shiny nights, of dancing in the fields; for which if you ask them the reason, all the answer they make you is, that it is a custom of the *Hottentots*, and handed down to them from their ancestors; now whether they rejoice in the light of the moon, which dispels that darkness, of which they are then most sensible, or whether they take her to be a rational being, endued with freedom of will, because of the variety of her forms, or for what other reason Mr. *Maxwel* will not pretend to determine; however, as they neither pray, nor sacrifice to any other thing, so neither do they to this; and upon enquiry, he could not find, that they paid any regard either to the sun or stars; the former of which at least, one would think, a people so grossly ignorant would pay some respect to, if they worshipped any God at all, that being the most glorious object of their senses; and accordingly, we find it affected all heathen nations, both the most barbarous, and the most polite; and in this single object, according to *Macrobius*, all their worship centered: Their great ignorance, Mr. *Maxwel* supposes, might partly be occasioned by *Africa* being peopled (as is probable) by that extremity of it, which joins to *Asia*; for the western coast is now, and always has been inhabited by *Negroes*, from whom it is not very

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very probable, that a people of so different a colour should have sprung; so that the more the inhabitants spread themselves towards the south, the less communication they had with the more civilized part of the world; the only shadow of government among them is, that in every neighbourhood, the eldest is first in order and dignity; his advice, as to what concerns the whole is most followed, as having the greatest experience: The ceremony of marriage is performed amongst them by the eldest person in the company, by sprinkling the parties to be married with his urine, upon which, and cutting out one of the man's *Testes*, the business is over; this, several who lived in the place averred for a certain truth; and upon searching a great many of them, Mr. *Maxwel* found it to be so; it is a mistake of *Nieuhoff* and others, who assert that the *Hottentots* cut out one of the *Testes* of their male children as soon as born, or at the age of 9 or 10; when a woman bears twins, she exposes one, and nurses the other; the reason of which is by some alledged to be the fear they have of their nations growing too numerous: The custom of revenging, rather than punishing, adultery with death, has prevailed amongst them; Mr. *Maxwel* was informed, that they abhorred polygamy, tho' some writers have asserted the contrary; when any person grows decrepid with age, their children or nearest relations, shut them up in their houses, and starve them to death; they bury their dead in the skins they wore when alive: Their food is for the most part roots, but chiefly one called by the *Dutch Ontee*, which is roundish, about the bigness of one's little finger, and hot in the mouth; their drink is milk and water; when they kill a sheep or a cow, they eat the guts and garbage, either slightly broiled, or quite raw; they are great lovers of tobacco and brandy, to purchase which of the *Dutch*, is all the use they make of money; they are no *Cannibals*: Notwithstanding their great ignorance, they distinguish several of the more remarkable stars, by names of their own imposing; yet they have no distinction of weeks, months, or years, any otherwise than by their rainy seasons; for if you ask a *Hottentot* how old he is, he answers so many rains; they watch the elephants where they use to water, and shoot them in the eye, where only they can wound them: This country produces lions, tygers, elephants, rhinoceros's, elks (whose hoofs are said not to have that virtue ascribed to them in northern climates) leopards, wild asses, one sort of which is finely streaked with white and dark brown, several sorts of beautiful wild goats, jackals, baboons, monkeys, deer, large cows,

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cows, and large ſheep without horns, with hair like a goat, inſtead of wool, and with large tails, both whoſe fleſh is very good; ſmall horſes, oſtriches, pellicans, hawks, magpies, wild peacocks, cranes, *Guiney* hens, penguins, flamingo's, rock-ducks, partridges, pheaſants, geeſe, common hens, turkeys, and ducks, &c. Here are likewiſe manatees, or ſea-cows, which are low, very thick and ill-ſhaped, with extreme ſhort feet, and yet they are very ſwift; they have no hair, but what grows about their noſtrils, they have large teeth, but without being noxious; they are not eaſily wounded, they live much in rivers, and are very ſhy; here are ſerpents of various kinds, with which, however they are not much infeſted; their ſoil produces moſt ſorts of fruits and plants that grow with us; as grapes of ſeveral kinds, apples, quinces, olives, oranges, apricocks, cherries, and ſeveral kinds of aloes, but none (that he ſaw) of the true ſort, ſuch as *Socotra* produces; they have pompions in abundance, cabbages, &c. corn, as wheat, barley, &c. of *Dutch* cultivation; here are likewiſe lizzards, ſalamanders, and porcupines; this place is fit to produce any vegetables, the ſoil and climate conſpiring thereto; here the *Dutch* have ſettled, for the conveniency of a rendezvous for their homeward bound *Eaſt-India* fleet, and they have poſſeſſed themſelves of the country for 60 miles from the place of their firſt ſettlement; beſides their principal town in *Table Valley* (ſo called from a neighbouring hill, ſtiled the *Table Land*, becauſe of its figure, from whence alſo the adjoining bay is called *Table Bay*) where they have a fort, an hoſpital, and a church, with about 300 families; they have two other ſmall towns in the county, called *Dragenſtein* and *Stallambuſs*, inhabited moſtly by *French* proteſtants, who make moſt of the wine the place produces, which is not inconſiderable, either for quantity, quality, or variety, reſembling *French* claret, *Rheniſh*, *Burgundy*, &c. they are about 120 families, and have one miniſter for both villages: In this place are reckoned about 2000 perſons fit to bear arms, and about 600 ſoldiers; no perſon that is not in their own ſervice, tho' a *Dutchman*, is admitted into their fort; they have prohibited the *Engliſh* to ſet up among them, tho' they have ſerved the uſual time of five years, which liberty they do not deny to thoſe of any other nation; and this is their practice in all the *Eaſt-India* ſettlements; however, when any *Engliſh* ſhip happens to touch here, diſabled in maſts, rigging, anchors, &c. they ſupply them for their money out of their ſtores; inſtead of cuſtoms and exciſe, they uſe monopolies; for the monopoly of wine of the growth of the place *An.* 1704, was

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was paid 59000 gilders, imported brandy 3000, and ſo of the reſt: All the public payments they make, are either for the watch, or for killing of lions and tygers, 20 dollars reward being given for killing a lion, and 10 for a tyger; the latter they hunt, but they only dare attempt the former by ſtratagem, and that in the following manner; when a lion in the night-time gets among their cattle, he commonly kills more than he eats at that time, whither he ſeldom fails to return the following night, to eat up the reſt; but before he comes, they take care to ſet mares about the prey, with muſquets diſpoſed in ſuch a manner, that in coming at it, he muſt neceſſarily draw the triggers, the muzzles being ſo planted, as that they ſeldom miſs him; but if he is not killed out-right, he wrecks his fury on the muſkets, by gnawing the ſtocks, and imprinting the marks of his teeth on the very iron; and tho' they are able to retire, yet they are known to watch there for two or three days, to ſee who comes to look after the execution, and they ſet upon them, if they are not well aware.

A ſort of pilgrims in the *Eaſt Indies* called *Tonquiers*, and who often have occaſion to travel thro' deſarts, have a ſurpriſing dexterity in killing theſe wild beaſts; for, when a *Tonquier* ſees one of them making towards him, he faces him, kneeling on one knee, and holds towards him a ſhort ſpear in his left-hand, upon which, the beaſt, making a ſpring at him, pitches and fixes his body, and then he runs a poiniard down his throat, which he carries in his walking ſtaff, and ſo kills him: When a tyger leaps at a man, if his firſt aim is avoided, he never as they ſay, makes a ſecond attempt.

The winds which blow at the *Cape of Good Hope*, are of the monſoon kind; for between the beginning of *March* and *September*, which is their winter, the wind blows for the moſt part between the north and weſt, during which time they have not much fair weather and from this rainy ſeaſon the *Hottentots* compute their year; but, during the other half year, the wind generally blows between ſouth and eaſt, accompanied with very fair weather; very often from the neighbouring hills, ſudden and violent guſts of wind come down on the adjacent parts: The company's garden, which is about 970 paces long, and 230 broad, was divided into 4 parts, in each of which grew a great many of the moſt remarkable vegetables; belonging to its reſpective quarter of the world; but, tho' the climate, ſoil and ſituation are very favourable, it is now much neglected, both in reſpect of its plants and walks, neither of which are extraordinary.

Mr. *Max-*

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Mr. *Maxwel* met at the *Cape* of *Good Hope*, with one Mr. *Kolben*, who told him, that the common ſalt there made uſe of by the *Dutch*, was left in hollow places of the earth's ſurface, after the ſun had evaporated the rain water, which ſeemed to him hardly credible; but if it is ſo, he ſuppoſes, it can ſcarcely proceed from any other cauſe, than the rain diſſolving a ſalt contained in the earth, which after the rain is evaporated, remains behind; and this is the more probable, as within five leagues of the fort, lies *Salt Bay*, ſo called from the vaſt quantity of ſalt dug near it.

The variation of the compaſs, or magnetic needle, in the *Atlantic* and *Æthiopic* oceans. A. D. 1706.

Variation.	Latitude.	Long. from *London*.
8° 32′ Weſt.	49° 18′ North.	0° 29′ Weſt.
6 42	44 31	13 45
5 30	41 06	15 08
5 04	40 22	14 54
4 22	39 11	15 35
3 30	32 21	15 39
3 35	32 42	15 38
1 20	18 50	20 52
1 14	09 26	17 59
1 10	00 49	18 42
1 00	01 09 South.	18 58
0 16	02 32	19 48
0 00	03 17	20 05
0 40 East.	03 58	20 27
1 02	05 09	21 39
1 30	06 21	22 08
1 50	08 03	23 15
2 10	09 07	23 35
3 32	12 03	25 03
6 04	18 53	26 30
6 19	19 51	27 02
6 20	21 26	28 14
6 30	21 48	28 10
7 00	21 58	28 23
6 45	24 45	27 56

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Variation.	Latitude.	Long. from *London*.
6 38 East.	27 11	27 17
5 04	33 53	16 58
0 00	34 21	01 29 30″
1 00 West.	34 15	01 33 East.
4 16	33 41	06 23
8 46	34 39	13 02
11 56	34 30	16 15 *At the Cape*
11 30	32 51	13 41 *of* Good
10 00	30 21	11 46 Hope.
09 44	29 51	11 44
09 34	29 28	11 31
09 22	28 56	11 05
09 04	27 38	10 01
08 30	26 55	08 45
08 02	25 41	07 22
07 32	24 32	05 43
01 52	16 00	06 30 West. *At the Isle of St.* Helena.

An Experiment, *shewing the Quantity of* Air *produced from a certain Quantity of* Gun-powder, *fired in common* Air; *by Mr.* Francis Hauksbee. Phil. Trans. N° 311. p. 2409.

MR. *Hauksbee* took a fine glass tube about 36 inches long, the diameter of its bore was about $\frac{1}{4}$ of an inch; its upper orifice had a brass ferrel sodered to a screw cemented on it, to which was screwed a cock; the lower part was open, without the bladder he formerly made use of; near the upper part of this tube, within it, was fixed a piece of cork, notched on its edges, to give the greater liberty for the explosion to vent itself; the cork had a small cavity in its middle, the better to receive and hold the gun-powder, which was let down on it thro' a small glass funnel, before the cock was screwed on; in this manner the lower orifice was plunged under the surface of a vessel of water; the cock being then screwed on and open, it was easy, by sucking with one's mouth, to exhaust the internal air, whereby the pressure of the external air would raise the water in it to any determinate height; the tube was previously measured by an accurate cubical inch, and graduated on its outside by a file; when the water had ascended to the designed mark by the above-mentioned means, the

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the cock was turned, which ſuſpended it there; then the focus of a burning-glaſs being caſt on the powder, it ſoon fired, blowing the water down violently; but ſuddenly riſing again, it remained ſo much below the mark it ſtood at before firing, as was equal to the quantity of ſeeming air produced from it; the quantity of gun-powder uſed in this experiment, was an exact grain weight; and Mr. *Hauksbee* found the quantity of ſpace the water had deſerted, juſt after the exploſion, to be nearly equal to the bulk of a cubical inch of gun-powder, whoſe weight was 222 grains; ſo that 222 grains weight of the ſame powder, as ſoon as fired, ſeems to produce ſomething that poſſeſſes the ſpace of ſo many cubical inches of air; now, whether the ſpace deſerted by the water is poſſeſſed by a body of the ſame weight and denſity, or of the ſame quality with common air, Mr. *Hauksbee* cannot determine; ſince an experiment he had made, to try how much the heat produced by the exploſion of gun-powder, might contribute to the largeneſs of the ſpace diſpoſſeſſed by the water, ſeems to conclude it otherwiſe; for he found, that when the gun-powder had been fired an hour, the water had aſcended about $\frac{1}{20}$ of the whole deſerted ſpace, which was about 2 inches and $\frac{1}{2}$ in length, and was equal to about a cubic inch; the ſpace in length was divided into 20 equal parts; at two hours after firing, it had aſcended near $\frac{2}{20}$ of the ſame; and by that time he judged, it might become of an equal degree of temperature with the external air; but ſtill continuing the experiment, he was ſurpriſed to find, that two hours after the laſt obſervation, the water had reached to about $\frac{1}{20}$; next morning, which was at about 18 hours interval, he obſerved it had arrived to near $\frac{1}{10}$, or half the firſt deſerted ſpace; and thus continuing to riſe, he found that at the end of 14 days, the water had aſcended ſomewhat above $\frac{1}{10}$ of the ſame; at 18 days it arrived to 19 of the 20 parts at firſt deſerted, and at that ſtation it continued without alteration for eight days; ſo that the ſeeming real air, produced from the fired grain weight of gun-powder, was only equal to the bulk of 11 grains of the ſame, that number being nearly the 20th part of 222, the number of grains contain'd in a cubical inch; which ſhews, that the whole ſpace at firſt deſerted by the water, upon firing the gun-powder, was not ſupplied with real air; the temperature of the air Mr. *Hauksbee* all along conſidered, and he found, that it contributed nothing to this odd phænomenon, which he could not tell how to account for; only, he ſuggeſts, that the ſprings, or conſtituent parts of the circumambient air, as well as thoſe contained in the body of the gun-powder, may upon firing, be capable of being broken, or at leaſt

ſo diſtended, as to poſſeſs ſo large a ſpace, and require ſo long a time to recover their natural ſtate again; and this, he ſuppoſes, could never have been diſcovered, but by the confinement of the ſame air, in which the exploſion was made: Tho' this experiment ſeems to be inconſiſtent with thoſe formerly made by firing of gun-powder *in Vacuo*, yet conſidering the different mediums in which the experiments were made, they may be the more eaſily reconcileable; for when the gun-powder was fired in ſo thin a medium, as the near approach to a *Vacuum*, the remaining air in the receiver could ſuffer by the exploſion, only in proportion to the quantity, which muſt be ſo inconſiderable, as not to deſerve any notice.

An Experiment, *ſhewing, that the Springs, or conſtituent Parts of* Air, *are capable of ſuffering ſuch Diſorder, by a violent Impulſe, as to require Time to recover their natural State; by the Same.* Phil. Tranſ. N° 311. p. 2412.

MR. *Hauksbee* took his condenſing engine, and into the bottom part of its braſs receiver he put about ½ a pint of water; then the upper part being ſtrongly ſcrewed on, he injected with the ſyringe about three or four atmoſpheres of air, ſuffering it to continue in that ſtate ſometimes more than an hour, then letting out as much of the air (by taking off the ſyringe) as would readily depart, he immediately ſcrewed on in its place a box of leather collars, thro' which paſſed a ſmall glaſs tube, whoſe lower orifice was plunged under the ſurface of the included water; in a very little time he found the water had aſcended in the tube near a foot, and it continued riſing for ſome time, 'till it had reached to near 16 inches; which plainly ſhews, that the ſprings of air, by being ſomewhat overbent, do not immediately, tho' at liberty, recover their priſtine ſtate; and were they to undergo a more violent preſſure, and to remain for a week, a month, or a year, in the ſame ſtate, Mr. *Hauksbee* doubts not, but that according to the length of time, and degrees of condenſation, a proportional time would be requiſite to recover them to their natural ſtate again; but the force made uſe of in this experiment is inconſiderable, in compariſon to that of fired gun-powder, where the ſuddenneſs and violence of the impulſe, is unaccountable; however, it very well ſerves to confirm Mr. *Hauksbee*'s ſuggeſtion, *viz.* that the air might ſuffer in its parts by a violent or unnatural extenſion of them, ſo as to require time to recover their priſtine natural ſtate.

Upon

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Upon a repetition of the ſame experiment, only the condenſed air remained in the ſame ſtate, as at firſt injected; for the ſpace of about 18 hours; then letting out the air as before, the above-mentioned box with its tube was ſcrewed on, and by obſervation, he found, that as the ſprings of the air unbent themſelves, ſo they preſſed more and more upon the ſurface of the included water, which raiſed it higher and higher in the tube, as they appoached nearer their natural ſtate; this continued for about ſix hours, at which time the little tube was accidentally broken, and farther obſervations for that time fruſtrated.

Some Things obſervable in diſſecting a Human Ear; *by Dr.* Archibald Adams. Phil. Tranſ. N° 311. p. 2414.

THE bony cavity of the ear is covered at each extremity by a membrane; the former is called the membrane of the drum, and the other is directly oppoſite thereto; the external one is ſtronger than the internal; they are connected together by the handle of the *Malleus* adhering to the external membrane, and by the upper part of the *Stapes* to the internal membrane, which by the intervention of the *Incus*, and the orbicular bone form a chain, and they ſeem to be acted on, and re-acted reciprocally by theſe ſmall bones; nothing more nearly reſembles the natural drum, than the artificial, the ſkins of this, anſwering to the membranes of that, and the wooden cylinder to the boney cavity; the ſound of the artificial drum would be flat without a hole in the ſide thereof, and nature has given a paſſage from the palate to the ear; the ſkins of the drum would leſſen the ſound, if they were not kept on the ſtretch, and in the ſame manner would thoſe of the other flag, if the handle of the *Malleus* and the *Stapes* did not keep them tenſe; this internal membrane is cloſely ſtretched before the labyrinth, the *Foramen rotundum*, and the paſſage into the *Cochlea*, that ſo the ſound may be augmented upon its approach to the nerves; the *Stapes* is generally broken in diſſecting the ear; particularly that cover which goes over the bone on each ſide; but if it be carefully opened, the *Stapes* is entirely covered with a membrane, which forms a cavity flatly oval, and the inſide excavated.

Mine-

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Mineral Waters at Canterbury; by Dr. Scipio des Moulins, Phil. Transf. N° 312. p. 2462.

A Mineral water was accidentally discovered at *Canterbury*; in digging the ground, they first met with a fat, black mold, extending itself three foot deep, and gradually changing into another sort of soil, very fat and resembling butter; this second layer was two foot thick, of a yellow colour, somewhat mixed; it was of a strong mineral smell, and a piece of it exposed for some time to the sun, smelt much like burning sulphur; after this, there was found a quicksand of a darker colour than the first soil, mixed with several little stones, and the smell was still stronger than before; two foot further under the quick-sand, there appeared a hard rock, out of which there gushed out water with some violence; they dug two wells at about seven foot distance from each other; one was about 8 or 9 foot deep from its surface, and 12 foot from the surface of the ground about it, and reached to the rock; the other was not so deep by two foot, and only touched the sand; this last is somewhat stronger of the sulphur; but the other is stronger of mineral spirits and ferruginous particles; two drachms of the second layer of earth, found in digging, being put into four ounces of spirit of vinegar, there presently arose a considerable ebullition, and soon after the spirit was tinged with a brownish yellow colour, which underwent no alteration by an infusion of logwood, or galls, but with oil of *Tartar per deliquium*, it turned greenish, and with an infusion of *Lignum Nephriticum*, it became of a pale red: The water taken up at the spring, is exceeding clear, but becomes somewhat whitish in a quarter of an hour, and in half an hour, the spirit is lost, and the mineral hangs first on the sides of the glass, and then gradually subsides to the bottom; it will not keep quite so well as the *Spaw* or *Tunbridge* waters; its taste is strong and austere, its smell ferruginous, and somewhat sulphureous, and it is said to smell like gun-powder; it will make the root of the tongue of such as drink it blackish; linnen washed therein turns yellow; it will not lather with soap; glasses dipped in the water become yellow, which no scouring can take off, and they are apt to fly; in frosty and cold weather, it is so warm, as to melt ice and snow; in other seasons it is cold, tho' not so cold, as some spring waters are; the weight of this water varies much, according to the season and weather; in *May* 1704, a pound of it weighed three grains lighter, than common water; in *Spring* 1705, it was equal in weight

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weight to common water, and in *August* following it was ſtill heavier, becauſe of the exceeding dry weather of that ſummer; but in general, about *Midſummer*, if the weather be no ways extraordinary, it is pretty equal to common water in weight; a ſingle grain weight of good galls will in an inſtant, turn a pint and half of this water of a very fine deep red; ſyrup of violets turns it to a graſs-green; an infuſion of *Braſil* wood gives it a deep vivid blue; that of *Lignum nephriticum* firſt a light green, then a light yellow, with a blue crown; an infuſion of logwood, a bluiſh black; that of fuſtic wood, a duſky yellow; that of the flowers of pomgranates, a fair violet; leaves of tea, a fine purple blue; good *Nants* brandy, an elegant ſky-colour; it turns a ſolution of *Saccharum Saturni* milky in an inſtant; and the ſolution of ſublimate in ſome longer time; *Oleum Tartari per deliquium*, *Spir. Sal. Armoniac*, *Sp. Vitriol*, &c. make no ſenſible alteration; in calm weather, eſpecially in winter, a thick oily film covers the ſurface of theſe waters, of as great a variety of colours, as a rainbow; a ſpoonful of it drank, has the ſame effect, and compoſes as much to ſleep, as a moderate doſe of *Opium*; ſome of this ſcum, dried by evaporation, taſtes very fat, and feels ſo between the fingers; and ſome of this powder, dropp'd upon a red-hot iron, moſt of it will immediately burn away with ſome ſparkling, and what remains is of the colour of the ruſt of iron, and taſtes partly ſtiptic and earthy, and partly ſaltiſh; the water itſelf gently evaporated, yields a yelloviſh ſediment, more or leſs, according to the ſeaſon of the year; the ſpring 1707 a quart of it yielded ſix grains, but in *September* following, the ſame quantity afforded nine grains; whereas, a pound of *Tunbridge* water yielded Mr. *Boyle*, only a ſingle grain of ſediment, as appears by his *Memoirs of mineral waters*; this ſediment, boiled in common water, made a ſtrong *Lixivium*, with which acids cauſed no ſenſible fermentation; but ſyrup of violets turned it green; this *Lixivium* after evaporation, yielded a fat ſulphureous ſalt, that would not coagulate into cryſtals; the Dr. could extract but three or four grains of it out of ten grains of ſediment; but from the colour and taſte of the *Lixivium*, he had reaſon to ſuſpect, that there is a larger proportion of ſaline particles therein, which as he ſuppoſes, being volatile, evaporate with the water: From the ſeveral ſurpriſing cures performed by it, he takes it to be one of the moſt excellent waters of this kind, yet diſcovered in *England*; the little well is very ſerviceable in diſeaſes of the breaſt, as in aſthma's, coughs, rheums, and catarrhs; it has cured ſeveral deſperate conſumptions; moſt diſorders of the ſtomach

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ſtomach are removed by theſe waters; they ſeldom fail in the cure of rheumatic gouty pains of the limbs, or other parts of the body; in the ſcurvy, and melancholy diſtempers, jaundice, vapours, all ſorts of obſtructions, ſcabs, itch, *&c.* but in the gravel, cholic, and green ſickneſs, it is a true ſpecific, as alſo in inward ulcers, if not too far gone; a certain perſon, who had been under the cure of ſeveral phyſicians, and diſcharged out of St. *Thomas*'s hoſpital, as incurable, was cured of an ulcer in his bladder, by drinking theſe waters for three months together; in agues they exceed the bark; the Dr. has ſeen ſome obſtinate agues, that could not be removed by the bark, perfectly cured by theſe waters, and ſome conſtitutions, quite worn out by frequent relapſes into this diſtemper, were reſtored again; this is alſo remarkable, that they agree beſt with old, decrepid, decayed and weak conſtitutions; the water ſits pleaſantly on the ſtomach, works off by urine very briſkly, cauſes a good appetite, chears the ſpirits, and procures ſleep; it is not binding, as other chalybeats are, but keeps the body open with moſt people, and to ſome it is now and then a gentle laxative, which carries off the diſtemper; the Dr. had preſcribed them for four years to ſeveral people every ſeaſon, and he could never obſerve any inconveniency, or bad ſymptom ariſe from the drinking thereof.

An Account of the Cure of two ſinuous Ulcers, *with an extraordinary* Callus; *by Mr.* John Fawler. Phil. Tranſ. N° 312. p. 2466.

ONE *John Marſh*, of the pariſh of *Denton* in the county of *Kent*, about 16 years of age, was at the end of a continued fever, troubled with a tumour on his arm, which ſeemed to be a critical diſcharge of the humour of the fever on that part; he was for two years under the care of a ſurgeon of that pariſh, but at length he came to Mr. *Fawler*; at firſt dreſſing he found two ſinuous ulcers in his right arm, one upwards about the deltoid muſcle, and the other on the under part of his arm, within an inch and a half of the juncture of the *Cubitus*; the upper *Sinus* paſſed upwards within an inch and half of the juncture, and downwards to the *Cubitus*; the lower *Sinus* paſſed downwards to the *Cubitus*, and upwards about an inch and half; when both theſe *Sinus*'s were laid open, the bone ſoon ſhewed itſelf carious and looſe, ſo that he eaſily took it out, and it was about five inches long; three weeks after, there came away another ſplinter of bone from the inner ſide, about two inches long, having the channel of the marrow; theſe ulcers, with care and diligence,

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diligence, were cured very well in nine months; and the place of the bone was so well supplied with a strong *Callus*, that the patient was not only very healthy, but could lift 50 pounds weight with that arm.

Two Deaf Persons, *who could speak, and understand what was said to them by the Motion of the* Lips; *by* Richard Walker *Esq.* Phil. Trans. N° 312. p. 2468.

A Certain person and his sister, each about 50 years of age, had not the least sense of hearing, yet both of them understood by the motion of the lips only, what was said to them, and would answer pertinently to any question propoſed to them within their capacity; so that a person need only whisper, provided the lips and mouth were but moved as they ought, and he did not speak too fast; *Mr. Walker* was told by their mother, that they could hear very well, and speak when they were children, but that both lost the sense of hearing afterwards, which made them retain their speech; tho' that, to persons not used to them, was a little uncouth and odd, but intelligible enough, especially the man's.

A Deaf *and* Dumb Person, *who recovered his* Speech *and* Hearing *after a violent* Fever, *&c. by Mr.* Martin. Phil. Trans. N° 312. p. 2469.

ONE *Daniel Fraser*, a native of *Stratharig*, about six miles from the town of *Inverness*, continued deaf and dumb from his birth, till the 17th year of his age, when he was taken ill of a violent fever, which upon letting blood, abated, but had not its natural course; about five or six months after, he relapsed again, and had no blood drawn from him, and then it proceeded in its natural course; some weeks after his recovery, he perceived a motion in his brain, which was very uneasy to him, and afterwards he began to hear, and in process of time to understand what was spoken; this naturally disposed him to imitate others, and attempt to speak; he was not understood distinctly for the space of some weeks, but in some time after he was understood tolerably well.

When the small pox is epidemical on the main-land over against the *Isle of Skey*, on the south-east and east, and likewise in the isle itself, the natives bathe their children in the infusion of juniper wood, and they generally escape; whereas, such as neglect this precaution, are often observed to die; of this Mr. *Martin* had several instances.

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Water-lilly, applied to a whitlow, is obſerved quickly to penetrate the ſkin of the part: A red hot iron, plunged an inch deep in the arm or leg cures ſeveral diſtempers: A wound, or ſcarification, a-croſs the crown of the head, cures fluxes and dyſenteries; and after the blood is ſtanched, the wound is cured as other wounds commonly are: They uſe ſilver-weed inſtead of hops in brewing beer.

An Obſervation of a Lunar Eclipſe *at* Boſton *in* New England, *on the 5th of* April *in the Evening*, A. D. 1707; *by Mr.* Thomas Brattle. Phil. Tranſ. N° 312. p. 2471. *Tranſlated from the* Latin.

The Immerſions	Time correct. by Alt. h.	′	″
THE *Penumbra* was very remarkable at	6	52	00
Palus Maræotis covered at	6	58	20
Mons Porphyrites begins	7	8	15
—— covered	7	9	20
—— *Ætna* begins	7	16	00
—— entirely covered	7	17	15
M. Sinai begins	7	21	40
—— entirely covered	7	22	40
Inſula Corſica covered	7	24	90
Lacus niger major covered	7	31	40
Inſula Lesbicus	7	33	00
Byzantium	7	36	30
M. Horminius	7	37	20
M. Apollonii	7	40	30
M. Hercules	7	44	30
M. Corax	7	51	30
Palus Mæotis begins	7	52	45
Inſula major in *Mari Caſpio* begins	7	54	45
—— covered	7	56	
Palus Mæotis entirely covered	7	57	30
The moon entirely immerſed	8	1	15

The Emerſions	°	′	h.	m.	
Comp. Alt. of *Arcturus*	53	34	8	28	
	51	30½	8	59	15

Comp.

	°	′	h.	′	″
Comp. Alt. of the ſtar that follows *Lucida* in *Corona ſeptentrionalis*	60	2	9	0	30
Lat. 44° 33′	56	57	9	17	15
The moon begins plainly to emerge			9	46	30
M. Ætna quite clear			10	9	30
M. Sinai quite clear			10	10	15
Inſula Besbicus			10	25	
Byzantium			10	28	30
M. Apollonii			10	33	
M. Hercules			10	36	30
Palus Mæotis begins			10	44	
Inſula major in Mari Caſpio reſtored			10	47	
Palus Mæotis quite clear			10	49	
The moon entirely emerged and clear			10	54	

Experiments *and* Obſervations *on* Sound; *by Mr.* Derham. Phil. Tranſ. N° 313. p. 2. *Tranſlated from the* Latin.

THE following table exhibits in *Engliſh* feet the progreſſive motion of ſound in a ſecond of time, according to the moſt celebrated authors.

	Feet	
Sir *Iſaac Newton*	968	*Princip. Phil. Nat. L.* 2. Prop. 50.
The Hon. Mr. *Roberts*	1300	*Phil. Tranſ.* N° 209
The Hon. Mr. *Boyle*	1200	Eſſay *of languid Motion.* p. 24
Dr. *Walker*	1338	*Phil. Tranſ.* N° 247
Merſennus	1474	*Baliſtic.* Prop. 39
Mr. *Flamſtead* and Dr. *Halley*	1142	*Exper. per Acad. del Cimen.* p. 141
The *Florentine* academy	1148	
The *French* obſervers	1172	Du *Hamel Hiſt. Acad. Reg.*

The difference between the two laſt ſave one is not great, nor that of the *French* much greater, but the reſt differ very widely; the reaſon of which is plainly this; *viz.* either the defect of the inſtruments, the diſtance at which the obſervations were made, or the winds. 1. The inſtrument ſome of theſe great men made uſe of, was not a regular movement, but a pendulum that vibrated ſeconds; but it is evident, to all converſant in theſe matters, that a common pendulum is much more incommodious, and not ſo accurate, as a movement, becauſe it is neceſſary, firſt to have the eye employed in obſerving the flaſh of

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the gun, and next the bob, or pendulum, and this takes up some time, and causes confusion; all which together with the slowness of our senses, and that of our capacity or attention, may cause a considerable error; especially, if 2. There is but a small distance between the sonorous body, and the observer; but it is manifest, that most of those celebrated authors, made their experiments only at the distance of a few feet, and measured by the reflection of the sound, or echo; for some of them scarcely measured above 6 or 700 feet, and others again not above a mile; and Mr. *Derham* always observed, that there was an uncertainty in experiments made at so small distances, tho' a person should use the best instruments; and the least error in such small distances, is to be reckoned considerable; for perhaps, the pendulum has run over half its arch after the last pulsation from the first emission of the sound, but that pulse is also brought into the account, as if the vibration had been full and complete; or possibly we anticipate a vibration; and after the sound has reached us, we reckon more or less than we should; or if the distance be of a sufficient length, yet an error may arise, if, 3. There is not a regard had to the winds: All these are certain, inevitable, and perpetual inconveniencies, that attend the mensuration of the progressive motion of sound; which at small distances, as was above-mentioned, especially, if the instruments are bad, may occasion great errors; and doubtless, these were the greatest cause of the difference among authors; but it may be observed, how nearly the spaces in the table, assigned by the three last observers, agree, which undoubtedly is owing to their using good movements, wherein the ear is only employed in receiving the vibrations of the pendulum, whilst the eye observes the flash, or some other signal of the emission of the sound; and these observations were made at pretty large distances, so that a small error is but of little consequence; Mr. *Flamstead* and Dr. *Halley* made their observations on *Shooter*'s-hill, almost three miles distant from the Royal observatory at *Greenwich*, and the sound reached them at 13 seconds and $\frac{1}{2}$ of time; those of the academy *del Cimento* made their experiments almost at the same distance, and some again they made at only a mile's distance; and lastly, M. *Cassini*, *Picard*, and *Roemer* made theirs at the distance of 1280 *French* toises, which is upwards of an *English* mile and $\frac{1}{4}$: In order to find out the truth amidst such a variety of observations, Mr. *Derham* made several experiments at different distances; *viz.* from one to 12 miles, and upwards; and in order to measure the time, he had a very accurate portable

ble movement, with a pendulum vibrating half seconds: And that he might proceed with the greater certainty, he proposed to himself to resolve the following queries. 1. How much space sound passes thro' in a second, or any other interval of time? 2. Whether a gun discharged towards the observer, transmit the report in the same space of time, as when discharged the contrary way? 3. Whether, in any state of the atmosphere, when the mercury either ascends or descends in the barometer, sound pass over the same space in the same interval of time? 4. Whether sound move with greater velocity in the day-time, than in the night? 5. Whether a favourable wind accelerate sound, and a contrary wind retard it; and how winds affect sound? 6. Whether sound move with a greater velocity in a calm day, than when the wind blows? 7. Whether a violent wind blowing transversely, accelerate or retard the motion of sound? 8. Whether sound have the same degree of motion in summer and winter, by day and by night? 9. And whether also in snowy, and fair weather? 10. Whether a great and small sound have the same degree of motion? 11. Whether in all elevations of a gun; *viz.* from point-blank to 10, 20, and 90 degrees, sound reach the observer's ear in the same space of time? 12. Whether all sorts of sounds, as those of guns, bells, hammers, *&c.* have the same degree of motion? 13. Whether the different strength of gun-powder vary the motion of sound? 14. Whether sound pass over the same space in the same interval of time, on the tops of high mountains, and in the bottom of valleys; or in the highest and lowest parts of the atmosphere? 15. Whether sound in acclivities and declivities have the same degree of motion; or whether it descend from the top to the foot of the hill with the same velocity, as it ascends from the foot to the top of the same? 16. Whether sound move swifter in the beginning, and slower in the end; as is the case in a great many other violent motions? 17. Or whether it be not rather equable? *viz.* moving in half the time, over half the space; in a fourth part of the time, a fourth part of the space, *&c.* 18. Whether sound have the same degree of motion in all climates; both north and south in *England*, *France*, *Italy*, *Germany*, &c? 19. Whether sound pass from one place to another in a strait line, or in the shortest way; or whether it move along the superficies of the intermediate earth?

To determine all which, Mr. *Derham* caused guns to be fired from towers, and other eminences, at the distance of 1, 2, 3, to 8 miles; but the guns that served his purpose best, were those at *Blackheath*, called lakers; whose flashes he could see from the turret

turret of *Upminſter* church, and hear the report almoſt in all weathers; and even in the day-time, he could with his teleſcope obſerve the flaſh.

The following experiment was made at the *Tower* of *London*; viz. two guns called ſakers, were planted hard by each other, with the muzzle of one turned towards Mr. *Derham*, and that of the other from him, and on *February* the 13, 170⅔, they were fired every half hour, from ſix o'clock in the evening till midnight, a gentle wind blowing directly againſt the ſound; the diſtance of time between the flaſh of each exploſion (which he could obſerve with his naked eye) and the report was always about 120 or 122 half ſeconds of time; for the report was double, the firſt, which was weaker, reached in about 120 half ſeconds, and the other, which was ſtronger, in about 122 half ſeconds; and in the ſame manner, there was a double report of each exploſion, during the whole time of the obſervation: This reduplication of the report ſeemed to Mr. *Derham* to be an echo, reflected as he ſuppoſed, from the mill of *Blackheath*, or the houſes thereabouts; and of this he had no reaſon to doubt, only it happened to interfere with the opinion of a certain friend of his, who ſuppoſed, that no echo could be heard, but what was produced by phonocamptic or reflecting objects, not far off from the obſerver; and nor by thoſe near the vocal or ſonorous body, or other diſtant objects.

Of the Repercuſſion of Sound at a Diſtance, or of a diſtant Echo.

And firſt Mr. *Derham* ſuppoſes, that an echo at a great diſtance is not contrary to the laws thereof; in the next place that the reduplication of the ſound came directly from *Blackheath*; for, the firſt report did not come from thence, and, the other as an echo from ſomewhere elſe; as beyond him, either on the right or left, or from any other part; and Mr. *Derham* often obſerved the ſame thing, when great guns were fired on the *Thames*, (eſpecially if the air was clear and calm) as the watch-guns morning and evening; after the report had reached his ears, he heard it running along the river a great way, and for ſeveral miles echoing back from the banks, mountains and rocks, that are very numerous on the *Kentiſh* coaſt; all this Mr. *Derham*'s friend would aſcribe to the repercuſſion of the houſes near him; but not to mention the weakneſs of the ſound, after running over a great many miles, and its incapacity, had it come ſo far, of being reflected by phonocamptic objects near the obſerver, rather than by thoſe near the ſonorous body

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body, Mr. *Derham* gives an inſtance, or two, whence it plainly appears, that an echo cauſed by reflecting objects near the ſonorous body, may be heard for ſeveral miles equally, as well as the primary ſound, and ſometimes be more intenſe than it: He often obſerved, that great guns fired in the evening on the *Thames*, about *Deptford* and *Cuckold's Point*, gave generally a double, triple, quadruple, *&c.* report, and that the latter reports were the loudeſt; and when he went to either hand, a furlong, or even a quarter, or half a mile, ſtill the ſound continued the ſame: Several great guns were fired ſomewhere between *Deptford* and *Cuckold's Point*, from a ſhip which Mr. *Derham* ſaw from *Upminſter* church; the report was five or ſix times repeated in this manner, Pl. III. Fi. 2. between the flaſh and the report he reckoned 122 half ſeconds, the wind blowing tranſverſly; therefore at that time the guns were diſtant from Mr. *Derham* upwards of 13 miles; the two firſt reports were weaker than the third, but the laſt were the loudeſt of all; and when Mr. *Derham* had gone $\frac{1}{4}$ of a mile to the right hand, the ſound was repeated in the ſame manner, as alſo when he went to the left; and in ſome of his ſtations, he plainly heard, beſides the repetition of the ſound, a languid echo reflected from *Upminſter* church, or the adjoining houſes; and this Mr. *Derham* frequently obſerved then, upon firing the guns; upon diſcharging a great gun ſomewhere on the *Thames*, either on this, or the otherſide of *Graveſend*, the report was repeated 8, 9, or 10 times at leaſt, according to this meaſure of time Fig. 3. Many took this repetition of the report, to be the firing of ſeveral guns in a ſea-fight; but, Mr. *Derham* ſuppoſed it to be no other than a polyphonous echo, proceeding from the exploſion of one or two guns reflected either from ſeveral adjoining ſhips, or from the ſhore; and what confirms this was, that he himſelf not only heard it, when he walked in his garden, but likewiſe ſeveral others, who were at a diſtance; and Mr. *Barret* heard the ſame repetition of the report at his houſe, about four miles from *Upminſter*; from all which it plainly appears, that the opinion of Mr. *Derham*'s friend about echo's is falſe.

Of an Echo, or the Repercuſſion of Sound in the Air.

When Mr. *Derham* heard the reports of great guns, eſpecially in a calm and clear air, he often obſerved that a murmuring noiſe high in the air, preceeded them; and in a thin cloud, he often heard the firing of guns, run for ſeveral miles high over head in the air, ſo that the murmuring noiſe continued for 15 ſeconds of time; the continuance of this murmuring noiſe, Mr. *Derham* ſup-

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ſuppoſes to proceed from vaporous particles ſuſpended in the atmoſphere, which oppoſe the courſe of the undulations of ſound, and reverberate them to the ears of the obſerver, like indefinite echo's, which we call the murmuring noiſe in the air; upon thoroughly conſidering theſe things, it will appear, that an echo, made at a diſtance, may be heard, and that the ſaid reduplication of the report of the guns on *Blackheath*, did undoubtedly proceed from *Blackheath* itſelf, as was ſaid above.

Of the Report of Guns fired in all Directions.

What Mr. *Derham* ſuggeſted of the report of the guns on *Blackheath*, he found the ſame to hold in all others; *viz.* that the motion of ſound is neither ſwifter nor ſlower, whether the gun be diſcharged with its muzzle towards the obſerver, or from him; as alſo, that there is no variation of the ſound, in any poſition of the gun, whether horizontal or vertical; nor in any elevations, as 10, 20, &c. degrees, as the academy *Del Cimento*, truly obſerved: Gun-powder, whether ſtrong or weak, and a greater or leſs quantity thereof be uſed, tho' it may increaſe or diminiſh the ſound, yet it neither accelerates, nor retards its motion.

Of the Motion of Sound in any Weather, and at any Time of the Year.

Kircher in his *Phonurg.* l. 1. cap. 1. *Præluſ.* 3. §. 2. affirms; *He always found the velocity of ſound, different, at different times, in the morning, at noon, in the evening, and at night*; but Mr. *Derham* (having a better chronometer, and being at a more convenient diſtance) never found the velocity of ſound different at theſe times; for, in all weathers, whether fair and clear, or cloudy and lowring; and whether it ſnow or rain (both which weaken very much the audibility of ſound) and whether it thunder or lighten; in hot or cold weather; by day or by night; in ſummer or in winter; or whether the mercury aſcend or deſcend in the barometer; in ſhort, in all the various ſtates of the atmoſphere (excepting only the winds) the motion of ſound is neither ſwifter nor ſlower; only it is more or leſs clear by that variation of the medium, which perhaps, might have deceived the ſagacious *Kircher*; hence it follows that the concluſions drawn by Dr. *Walker*, from his own ingenious obſervations, and from thoſe of Dr. *Plot* and *Kircher*, are erroneous.

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Of the Motion of an intenſe and languid Sound, and of various ſonorous Bodies.

Tho' *Kircher*, *ibid.* be of a different opinion, yet Mr. *Derham* doubts not; but that the ſounds of all bodies, as guns, bells, hammers, *&c.* have the ſame degree of velocity; and for this end he compared the ſtrokes of a hammer, and the report of a gun, at the diſtance of a mile (being the greateſt at which he could hear the ſound of a hammer) and he found, that the ſound of both reached him in the ſame time; and that it had paſſed over $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$ of the ſame ſpace, in $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ of the ſame time; and as to intenſe and languid ſounds, Mr. *Derham* is perſuaded, they paſs thro' the ſame ſpace in the ſame time; as appears in ſome meaſure from the following experiments. At *Tilbury Fort* were fired one or two guns, and a great gun, into which the powder was well rammed; the report of all theſe reached Mr. *Derham*, who was about three miles off, at the ſame time: After ſun-ſet ſome muſkets, ſakers, and mortars were diſcharged on *Blackheath*, Mr. *Derham* could not hear the muſkets, either by reaſon of the great diſtance, or becauſe the air was not clear enough; yet he heard the ſakers and mortars in the ſame ſpace of time, tho' the report of the mortars was more languid and weak, than that of the ſakers.

Of the equable Motion of Sound.

And this Mr. *Derham* found to be the ſame, with what the academy *Del Cimento* had determined; for ſounds paſs over half the diſtance in half the time, and a fourth part of the diſtance in a fourth part of the time, and ſo on; as appears from the examples in the following table.

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The Place where the Explosion was made.	The Numb. of Vibrat. of the Pendul.	Distance of Places. By Trigon.	Distance of Places. By Sound.	Direction of the Winds.
		Miles	Miles	
At *Horn-church*	9	0. 9875		tranſverſe
At North *Okendon* church	18 ½	2. 004	2. 0	tranſverſe
Upminſter mill	22 ½ / 23	2. 04	2. 4 / 2. 48	favouring / ſnow tran.
Little *Warley* church.	27 ½	3. 0	2. 97	ſtrong fav.
Rainham church.	33 ¼	3. 58	3. 59	tranſverſe
Alvely mill.	33	3. 58	3. 57	tranſverſe
Dagenham church	35	3. 85	3. 78	favouring
South *Weal* church	45	4. 59	4. 86	tranſverſe
Eaſt *Thorndon* church.	46 ½	5. 09	5. 03	a little favour.
Barking church	70 ½	7. 7	7. 62	favouring
Guns at *Blackheath.*	116	12. 5	12. 55	tranſverſe

Mr. *Derham* meaſured very accurately either with a rod, or trigonometrically, the diſtances (ſet down in this table) of the places from *Upminſter*, where he made his obſervations; the truth of which, and the goodneſs of his inſtruments, appear from the great agreement between the diſtances meaſured in that manner, and thoſe meaſured by the motion of ſound; ſo that the difference was almoſt none at all, or but a few centeſimal parts, unleſs when the wind was favourable, excepting at *South Weal* church, of which hereafter; ſo likewiſe in the obſervations made at the churches of *Dagenham*, *Warley*, *Thorndon* and *Barking*, the diſtances, meaſured by the ſound, ſeemed to be a little ſhorter, becauſe the wind accelerated the ſound; but in computing this column of the diſtances by the ſound, Mr. *Derham* made no allowance for the acceleration of the winds, only he divided the number of vibrations or half ſeconds by $9\frac{1}{4}$, or 9, 25, the number of half ſeconds that ſound moves in a mile; the equable motion of ſound is alſo evident from this table, by comparing the vibrations and diſtances; or from the ſingle column of diſtances by the ſound: To confirm all this, Mr. *Derham* went to *Foulney-ſands*, on the *Eſſex* coaſt, which form a large and regular plain, of ſeveral miles in length; and there he meaſured ſix miles, and almoſt at the end of each mile he made experiments, by firing guns; whereby

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whereby he found that all his former obſervations were very juſt and true; *viz.* that ſound moves a mile in 9 half ſeconds and $\frac{1}{4}$, two miles in 18 and $\frac{1}{2}$, and three miles in 27 half ſeconds and $\frac{3}{4}$, and ſo on.

Of the Motion of Sound in Acclivities and Declivities, or of its Aſcent and Deſcent; as alſo whether it move from one Place to another, in a right Line, or according to the Superficies of the intermediate Earth?

As to the 15th and 19th queries, Mr. *Derham* frankly owns, he could not be ſatisfied by all the experiments he made to that purpoſe; and firſt as the progreſſive motion of ſound in the ſhorteſt line, *Quer.* 19. he had reaſon to doubt thereof, from the difference of the diſtance, meaſured trigonometrically, and by the ſound, between *Weal* and *Upminſter*, as in the above table; the trigonometrical menſuration was taken ſo many different ways and with ſo large angles, as to leave no doubt on that head; but becauſe the diſtance ſeemed by the motion of the ſound, to be greater, and becauſe the ſuperficies of the intermediate ground is as repreſented Plate III. Fig. 4. therefore, he ſuſpected whether the ſound had not a vavy or undulated motion; or whether the intermediate acclivity in A, did not repreſs and retard its undulations: In order to ſolve this difficulty in ſome meaſure, he cauſed a muſket to be fired from the top of *Langdon-hill*, into the valley below it, at 3. 79 miles off; the diſtance was accurately meaſured trigonometrically, by taking pretty large angles and a baſe; and when the experiment was made, a gentle wind blew ſomewhat againſt the ſound; between the flaſh and report, he reckon'd 35 half ſeconds and $\frac{1}{2}$; which number does ſo quadrate with the diſtance, and ſo nearly agree with the other experiments, that there is no manner of doubt, but the ſound deſcended thro' the air, in a right-line from the top of the hill to the bottom of the valley, and not according to the incurvated ſurface of the intermediate ground; and therefore Mr. *Derham* ſuppoſes, that there was ſome ſmall overſight in the obſervations made at *Weal*, becauſe he neither obſerved any ſuch thing in the experiment made at *Langdon*, nor in any others: Whether ſound move equally in aſcents and deſcents, that is, from the top to the foot of a hill, and from the foot to the top of the ſame, Mr. *Derham* deſpaired of ever ſatisfying himſelf; for want of hills of a ſufficient height, for making a competent number of experiments to this purpoſe.

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Of the Motion of Sounds in Italy.

Mr. *Derham* was informed by Mr. *Richard Townley*, that ſound is ſeldom heard at *Rome*, at ſuch diſtances as in *England*, and the northern climates; particularly he affirmed, that when he was at *Rome*, and the guns of the caſtle of St. *Angelo* were fired, the report was much more languid on *Monte Trinita*, than any other place at the ſame diſtance. And Mr. *Townley*'s brother alſo affirmed, that being once at the caſtle of *Gendolfo* (a place upon an eminence near lake *Albanus*, about 12 *Italian* miles from *Rome*) the report of the great guns from the caſtle of St. *Angelo* ſeemed to him languid and weak; and at another time, riding in his chariot round the walls of the ſaid caſtle, the report did not ſeem ſo loud there, as elſewhere; but Dr. *Newton*, envoy at the court of *Florence*, informed Mr. *Derham*, that travelling from *Bologna* to *Florence*, he heard at St. *Michael*'s in *Boſco*, near *Bologna*, the report of the great guns of *Mirandula*, tho' 40 miles off; and the following night he heard them in the *Apennine* mountains, 20 miles farther off: S. *Averrani*, by order of the great duke, cauſed a culverine to be diſcharged ſeveral times, in the lower caſtle of *Florence*, between the firſt and third hours of the night, and ſome were appointed at *Leghorn* to obſerve the report; thoſe ſtationed at *Lanterna* and *Mazzocco*, heard nothing of it (perhaps the roaring of the ſea drowned the ſound) but others, that were on the works of the old caſtle, called *Donjon*, and ſent to *Monte Rotondo* (about five miles from *Leghorn* towards *Monte Nero*) heard it diſtinctly; the diſtance of this caſtle of *Florence* from *Monte Rotondo*, is in a right-line computed to be little leſs than 55 miles; and it is obſervable, that the intermediate country is hilly, which muſt neceſſarily retard ſomewhat the velocity of the ſound; add to this, that the ſame evening there was a gentle weſterly wind, which (*Leghorn* being ſituated to the ſouth weſt in reſpect of *Florence*) muſt be ſuppoſed to hinder in ſome meaſure the free expanſion of the ſound; but in order to have an open free place, that tract of the ſea between *Leghorn* and *Porto Ferraio*, was pitched upon, which according to the calculation of the moſt ſkilful ſailors is about 60 miles; and any wind, whether with or againſt it, retards the ſound and renders it leſs ſonorous; the reaſon of which may be, that the roaring of the agitated ſea marrs it more, than the current of the air the ſame way aſſiſts it; therefore the ſound is then only heard, when the wind is quite ſtill or blows but very ſoftly, when the air is clear, and the ſea calm;

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calm; nor is it then heard indifferently in all places, but where the ſituation happens to be a little higher than ordinary; ſuch are the two forts, *Stella* and *Falconæ*, and a place called *Mulini*; beſides it is requiſite, that the obſerver be as attentive as poſſible, and be not diſturbed with the leaſt noiſe; and then it is heard in the day-time as well as in the night, provided the atmoſphere be clear and calm, only that the ſound ſeems ſtronger and ſomewhat acuter in the night, when there happens no noiſe, as is frequently the caſe in the day-time; moreover, S. *Averrani* was credibly informed that at the ſiege of *Meſſina*, the report of the great guns reached the ears of the inhabitants of *Auguſta* and *Syracuſe*, at almoſt 100 *Italian* miles; and likewiſe when the *French* beſieged *Genoa*, the firing of their guns was plainly heard as far as *Monte Nero*, upwards of 90 *Italian* miles: And from theſe obſervations *Averrani* is apt to think, there is no difference in this matter, between *Italy* and the northern climates: As to the other query, *viz.* Whether a favourable or contrary wind, accelerate or retard the ſound? The experiments *Averrani* had hitherto tried were inſufficient to reſolve it; only he gives an account of the following one, *viz.* a culverine was brought upon the courtine of the lower baſtion of *Florence*, and planted with its muzzle towards *Artemino* a palace of the grand duke of *Tuſcany*, ſituated upon a riſing ground, and regarding the weſt flank of the ſaid baſtion from which it is alſo diſtant about 12 miles; he choſe a day to make the experiment, when there was a pretty ſtrong weſterly wind, that the motion of the ſound might be repelled by the contrary wind; but all this was to no purpoſe; for the evening was ſo calm, that there was hardly a breath of air; *Averrani*, having left in this place ſome perſons ſkilful in thoſe matters, with proper directions, retired to the palace of *Artemino*, and the ſaid culverine was ſeveral times diſcharged, between the firſt and third hours of the night, and each time he reckoned 49 ſeconds between the flaſh and the report; he alſo cauſed ſome guns to be diſcharged at *Artemino*, and between the flaſh and the report of each exploſion the perſons above-mentioned only reckoned 48 ſeconds; whence it appeared, that the ſound moved ſwifter by a ſecond from *Artemino* to *Florence*, than from *Florence* to *Artemino*; yet he could not ſo far depend on his obſervation, as to aſcribe this ſmall difference of velocity, either to the concurrence or reſiſtance of the wind; becauſe it might be owing to the obſerver, who reckoned the vibrations of the pendulum; for it muſt often happen, that he cannot ſee the flaſh till the pendulum begin to vibrate, nor hear the ſound before the vibration is quite ended; ſo that his calculation

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lation is greater by one vibration, than it ſhould be, tho' the ſpace be otherwiſe equal, and the ſame: As to the ſpace ſound paſſes over in any given time, it is not hitherto determined; but be conjectured from ſome experiments, that the caſe ſtood according to thoſe made by the academy *del Cimento:* From theſe obſervations, it plainly appears, that ſound may be heard at a much greater diſtance in *Italy*, than Mr. *Townley* would have it; and Mr. *Derham* could not help thinking, but that ſound is propagated to as great diſtances in ſouthern, as in northern climates, tho' there are not inſtances wanting of the conſiderable progreſſive motion of ſound in ſome northern parts of the globe; for a certain *Daniſh* gentleman told him, he heard diſtinctly the firing of the guns of *Carolſcoon*, at 80 *Engliſh* miles diſtance; and Dr. *Hearn* informed our Royal Society, that the firing of the guns at *Stockholm* was heard at the diſtance of 30 *Swediſh* miles, which are almoſt equal to 180 *Engliſh*; and in the naval engagement, *A. D.* 1672 between the *Engliſh* and *Dutch* the report of their guns was heard upwards of 200 miles off, even as far as *Shrewsbury* and *Wales:* As to what the two Mr. *Townley*'s have obſerved, it ſeems to be peculiar to the caſtle of St. *Angelo*, or at leaſt to *Rome*; and that diminution of ſound, which they obſerved, Mr. *Derham* ſuppoſes, might be owing either to the ſituation of the caſtle, or to the intermediate houſes in that vaſtly large city, or to the ſeveral reflections of the ſound, or to contrary winds, or in fine to ſome ſuch ſimilar cauſe; or perhaps, theſe gentlemen made the above obſervations, when the air was in ſuch a ſtate, that tho' the ſound had the moſt favourable wind to concur with it, yet it was much more languid, than at other times, when the wind is entirely againſt it; and formerly Mr. *Derham* himſelf was of opinion, that there was always the ſame temperament of air at *Rome*, tho' not in the other parts of *Italy*, till he had read *Kircher*'s opinion, *viz.* that at *Rome*, which is ſurpriſing, the echo or ſound acquires great ſtrength with a northerly wind; grows languid with a ſoutherly wind, and is in a mean ſtate between both with an eaſterly, and an eaſt-ſouth-eaſt wind.

Of the various remiſsneſs and intenſeneſs, or audibility of ſound, according to the different ſtate of the atmoſphere.

Mr. *Derham* often obſerved, that ſound had an exceeding languid motion in ſummer, when the air was warm; but at other times, eſpecially in the winter, if it happened to freeze, it was much more acute and ſtrong; he alſo found that ſound is more

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more clear and ſhrill, with a northerly or eaſterly wind, however contrary, than if it blow from oppoſite points, as *Kircher* likewiſe obſerved at *Rome*; but this is not a conſtant rule: Nor could Mr. *Derham* determine any thing with more certainty, as he was apt to think he could, from the aſcent or deſcent of the mercury in the barometer; for he obſerved, the ſound to be ſometimes moſt clear and ſhrill, and at other times, moſt weak and languid, when it roſe the higheſt; and on the contrary, when it was loweſt, he found the ſound ſometimes very ſhrill, and at other times very weak: And the caſe is likewiſe incertain, as to fair and cloudy weather; for he often obſerved, that in a rainy wet ſeaſon the ſound was impaired, and after heavy ſhowers of rain, as *Kircher* found at *Rome*, it acquired a great deal of ſtrength, yet the caſe is often quite otherwiſe; at *Upminſter May* 31ſt 1705, the air was clearer and freer of vapours, than ever Mr. *Derham* obſerved it before, ſo that he could eaſily and diſtinctly ſee objects at a conſiderable diſtance; yet he could not hear at that time the report of the great guns on *Blackheath* (excepting one, which was quite languid, when it reached his ears) tho' he plainly ſaw all the flaſhes, and at the ſame time the motion of the clouds and wind conſpired with the ſound, there being a very gentle gale abroad, and in fine, tho' every thing ſeemed to contribute both to the force and motion of the ſound; but on the contrary, when the atmoſphere was quite changed, and full of vapours, and all ſeemed louring, he often heard the ſound ſhrill, and again as often languid, and remiſs: The cauſes of theſe variations Mr. *Derham* leaves to others to determine, as alſo to aſſign the proper medium or vehicle of ſound; whether it be the æthereal and more ſubtile part of the atmoſphere, or the vaporous and groſſer parts thereof, or both together? But as to thick clouds, it is certain, they very much weaken ſound, which for the moſt part, ſeems to be then languid and dull; and this doubtleſs, proceeds from the interpoſition of vapours, and the groſs particles which form the cloud; Mr. *Derham* likewiſe obſerved the ſame thing in ſnowy weather; for when ſnow is newly fallen, ſounds are preſently weakened, but as ſoon as its ſurface is frozen, they ſuddenly become more acute; and he has heard the ringing of bells and firing of cannon, as diſtinctly as if there had fallen no ſnow at all: Mr. *Townley* affirmed he had once obſerved, (as Mr. *Derham* himſelf had alſo done) that riding thro' a certain town, the ſound of the bells that were ringing but a little way off, could hardly reach his ears, if a houſe covered with ſnow happened to interpoſe; ſo that when he entered the town,

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town, he was exceedingly surprised to find, whilst he passed by the first houses that interposed, the bells to be silent of a sudden, but as soon as he came to the next vacant space, presently to be heard again, and this Mr. *Townley* observed all the way thro' that town; *viz.* that the sound of the bells either did, or did not reach his ears, according as the houses covered with snow happened to interpose or not.

The academy *del Cimento* found by experiments, that the motion of sound was neither retarded by contrary winds, nor accelerated by favourable ones, but that from whatever quarter the wind blew, sound passed over, the same space in the same time; *Gassendus*, and almost all the other philosophers, were of the same opinion, tho' the contrary appears from experience; and they seem to have fallen into this error, from the experiments being made at too short distances; as one, two, or at most three miles; whereas, had they made their observations (as Mr. *Derham* often did) with accurate instruments, at 10 or 12 miles distance, they would easily have found out the mistake; and he himself had (from the authority of those philosophers) given in for some time to this common error, till by the frequent observation of the firing of guns on *Blackheath* for three years and upwards, he was happily undeceived; at first when he observed the report reach his ears, sometimes sooner, and sometimes later, he began to suspect his accuracy either in reckoning the vibrations of the movement, or in exactly observing the flash of the gun, or that he had, thro' inadvertency, fallen into some such other mistake; but after he caused guns to be fired every half hour from six in the evening till midnight, and found the report always reach his ears, without any remarkable variation, in 120 or 122 half seconds of time, tho' the wind was directly against it; but at other times, when the wind was favourable and blew, either directly, transversely, or obliquely, observing the report of the same guns reach in 111, 112, 113, 114, 115, 116, or at most in 117 half seconds of time, he was at length assured, that some real difference caused this variety in the observations: And not only do winds with or against the sound accelerate or retard its motion, but likewise according to the various degrees of their strength and weakness, is the sound more or less promoted or impeded; of which Mr. *Derham* made particular observations, as in the following table; where it is to be observed, that the guns were about 60 degrees from the south, that is, pointed something better than S W. and by W.

A Table

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Day of the month and year	Hour of the day	number of vibrations	point of the wind	point of the clouds	height of the mer.
1704					
Feb. 13	6 o'clock to midnight.	120 122	N. E. by E. 1	N. E. b E.	29 99
21	11 half o'clock M.	119	E. 2	E	30 22
1705					
Mar. 30	10 o'clock M.	113	S. W. 7	S. W.	29 30
Apr. 2	8 half P. M.	114 half	S. by W. 1		
3	10 M.	116 half	S. 4	the inferior S. the sup. W. b N.	29 80
5	1 P. M.	111	S. W. b W. 7	S. W. b W.	29 70
13	8 half M.	120	N. b E. 2		29 26
24	5 P. M.	116	S. W. b W. 0	N. W.	29 59
Sep. 11	6 half P. M. 7 P. M.	115 115 half	W. 2 W. b N. 2	W. b N.	faker mortir
29	10 half M.	112	S. S. W. 6	S. S. W.	29 38
Oct. 6	10 M.	117	E. S. E. 1 and 2	S. E.	29 34
Nov. 30	at noon	115	S. S. W. 4	S. S. W.	29 16
Feb. 15	11 M.	116	S. b W. 1	S. W.	29 69
1706					
Nov. 29	11 half M. at noon	116 118	S. W. 0 S. W. b S. 1	S. W. b W.	30 6
Feb. 7	at noon	113	S. W. b N. 4	W.	29 83

Mr. *Derham* ſelected theſe obſervations from a great many others, which were all carefully made, each of them being repeated twice or thrice, or oftener; ſo that it appears from the experiments in *April* 5th and *Sept.* 29th, that the ſtronger winds accelerated the motion of ſound; for on the 5th of *April* when the motion both of wind and ſound almoſt conſpired, and the ſame wind was ſomething ſtronger (as the annexed cipher 7 ſhews, in the ſame manner that 0 denotes a calm, and 1, 2, 3, 4, *&c.* the different ſtrength of the winds) the ſound at that time reached in 111 half ſeconds of time; but on *April* 24th, when the wind blew from the ſame point, and the air was calm, the ſound moved thro' the ſame ſpace, only in 116 half ſeconds; ſo likewiſe on *Feb.* 7th 1706, the wind blowing on the ſame point, and carrying the ſound along with it, but with half the

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force, it passed over the same space in 113 half seconds; and in fine, on *Sept.* 29th 1705, the wind being strong and less favourable, the sound moved thro' the same space in 112 half seconds; from which and other examples in the table it plainly appears, that a strong wind accelerates sound, whilst a weaker wind does not; The same may likewise be said of these winds, or currents of air, which either directly favour, or oppose the progressive motion of sound; *viz.* that they either accelerate or retard it; and that intermediate currents do also cause intermediate progressions of sound, or number of vibrations of the pendulum: The greatest difference Mr. *Derham* observed in the motion of sound in the space of almost 13 miles, was about 9 or 10 half seconds, when a strong wind promotes, and only a gentle wind impedes it; but when only a gentle wind or almost none at all opposes, or favours the sound, the difference hardly exceeds two or three half seconds.

Of the velocity of winds.

In order to discover the quantity of space winds pass over, in any given time, Mr. *Derham* took some light bodies, such as down, *&c.* and from the several experiments he made with these, when the strength of the wind was different, he found that the strongest wind scarcely passed over 60 miles in an hour; *e. g.* on *August* 11th 1705, the violence of the wind was such, as almost to beat down a wind-mill, near the place where Mr. *Derham* made his observations; and estimating by the numeral characters, 0, 1, 2, 3, 4, 5, 6, to 10, 15, or more degrees the strength of winds, the strength of this he reckoned at about 12 or 14 of these degrees; and from repeated experiments he found, that that hurricane passed over about 33 feet, in a half second of time, or 45 miles in an hour; whence he concludes, that the most violent storms (not excepting that in *Nov.* 1703) do not move above 50 or 60 miles in an hour; and having thus determined the velocity of rapid winds, we may from thence more easily conjecture the velocity of such as are less so; and Mr. *Derham* found from several experiments, that some of them move 15 miles, others 13, some more and some fewer, in an hour; and that others again have so slow a motion, as scarcely to pass over a mile in an hour; moreover, some are slow, that a person, walking or riding, may easily outrun them, as is apparent to sense; for as often as we stop our pace, we perceive a gentle gale softly fanning us, but if we walk with the same space, that the wind moves, we hardly feel any at all; if faster, we find, that

that inſtead of accompanying and blowing with us, it blows in our faces; ſo that when the atmoſphere is quite calm, if we are walking or riding, we perceive a gentle gale, correſponding to the motion we are in; and the gale of wind, or flux of air moves with the ſame degree of velocity, we find it affect us, whilſt we ſtand ſtill.

From theſe obſervations on the velocity of winds, we may make a great many uſeful remarks; eſpecially, give one good reaſon, why the mercury aſcends and deſcends ſo long, before fair weather, or rain: Since ſound is ſwifter than wind, it is plain, that thoſe parts of the atmoſphere, whereon it is impreſſed or conveyed, are not the ſame with thoſe of which wind conſiſts, but ſome other more æthereal and volatile particles; for the ſwifteſt wind does not move above 60 miles in an hour, whereas ſound moves in the ſame time upwards of 700 miles; but if it ſhould be objected, that winds either accelerate or retard the motion of ſound, it may be anſwered, that this does not proceed from the proper flux or tendency of the windy particles alone, but rather from the joint and concurring motion of both the groſs and æthereal particles of the atmoſphere; which courſe or direction of motion ſhould it favour the undulations of ſound, its appulſe, it is very probable, would thereby be accelerated, but contrary thereto, it would be retarded.

Of the velocity of ſounds.

From what has been ſaid above, Mr. *Derham* firmly concludes, that ſound is propagated with this degree of velocity; *viz.* that in nine half ſeconds and $\frac{1}{4}$ it moves the ſpace of a mile, or 5280 *Engliſh* feet; or which is the ſame thing, 571 feet in a half ſecond of time, or 1142 feet in a whole ſecond; thus, ſound moves thro' the above ſpace, if the flux of the atmoſphere or wind be tranſverſe or acroſs, and is its mean motion; but ſhould the wind increaſe the rapidity of ſound, it is poſſible, it may move upwards of 600 feet in a half ſecond of time; or on the contrary, ſhould it retard ſound, it may move not above 560 feet in the ſame time: All the above mentioned obſervations and experiments may be uſeful. 1. To the philoſopher, for inveſtigating the nature of ſound, and explaining its obſtruſe *Phænomena.* 2. To the ſailor for diſcovering the diſtances of ſhips, either under ſail, or at anchor, and of land ſeen a great way off; all which he may know with eaſe and certainty, by the firing of guns. 3. To the ſoldier, for finding the diſtance of an enemy's camp, and that of a city, caſtle or arſenal, *&c.* that is

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to be beſieged, in order to level his batteries, and direct his mortars and bombs. 4. To the geographer, for meaſuring with the greater eaſe and certainty the diſtances of places; for any one furniſhed with a large quantity of gun-powder, may by this means in an hour or two, make a very accurate map of almoſt a whole country; the report of guns will ſhew, as has been ſaid, the diſtances of the places, and any mathematical inſtrument that meaſures angles, as the plain table, *&c.* will give their ſituation, ſo that they may afterwards be eaſily delineated; and in like manner by this means may any one readily diſcover the juſtneſs and accuracy of maps, and correct their errors; in fine, this method of obſervation may be of ſingular ſervice in meaſuring inacceſſible diſtances, eſpecially very broad rivers, *&c.* that cannot be otherways meaſured; as alſo for finding the breadth of bays and ſtraights. 5. To the echometrician; tho' ſeveral learned men, both ancient and modern, have carefully examined into that ludicrous and agreeable phænomenon of ſound, called echo, yet they are not well agreed in a great many points relating thereto; eſpecially, as to the ſpace, neceſſary for the repetition of 1, 2, 3, or more ſyllables, or which is the ſame thing, the ſpace an echo moves thro, in any given time; *Merſennus* allows .... paces, *Blancanus* 24 paces (with whom agrees Dr. *Plott*) but *Kircher* aſſerts that nothing certain can at all be determined therein; becauſe the variation of the winds, the intenſeneſs and remiſneſs of ſound, and a great many other circumſtances may cauſe a vaſt odds: It is an eaſy matter to aſſign the reaſon of the variety of theſe obſervations; as the ſlowneſs and various diſpoſition of our ſenſes, the different audibility of ſound, the grave or acute ſound of the ſyllables themſelves, or their length or ſhortneſs, or ſome other cauſe, that protracts the time of their pronunciation; for Mr. *Derham* is perſuaded that tho' any reflecting object were capable of returning all the ſyllables of the following verſe;

Vocalis Nymphæ, quæ nec reticere loquenti.

Yet it could not reflect all the ſyllables of this other, becauſe its pronunciation is a little longer;

Corpus adhuc Echo, non Vox erat, & tamen Uſum.

And much leſs repeat all the rough and long ſyllables of the following verſe, tho' fewer in number; *viz.*

Arx,

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Arx, tridens, roſtris, ſphinx, præſter, torrida, ſeps, ſtrix.

But from the above-mentioned obſervations on the motion of ſound, we may conclude, that as ſounds, ſo do echo's in like manner move thro' certain and determinate ſpaces in given times, as Mr. *Derham* often found by experience; *viz.* that the echo returns in double the time, wherein the primary voice arrives at the reflecting object; *e. g.* ſhould the phonocamptic or reflecting object be at the diſtance of a furlong, the return of the echo will be made in the ſame time, that the primary ſound would move thro' two furlongs, if it were not reflected; and this Mr. *Derham* often found to be very ſerviceable to him in meaſuring diſtances; *e. g.* ſtanding upon the banks of the *Thames*, oppoſite to *Woolwich*, the echo of a monoſyllable was reflected from the oppoſite houſes in ſix half ſeconds of time; hence he concluded, the breadth of the river in that place, from one ſide to the other, to be 1712 *Engliſh* feet, or upwards of $\frac{1}{4}$ of a mile; for as 9,25 half ſeconds: to 5280 (the number of feet in a mile) :: 6 half ſeconds: to 3424, 8 feet, the half of which is 1712, 4 feet. 6. In fine the height of thunder-clouds, as alſo the diſtance of the thunder and lightning itſelf may by this means be eaſily known.

An Account of the ſtrange effects of Thunder *and* Lightning; *by* Samuel Molyneux *Eſq.* Phil. Tranſ. N° 313. p. 56.

MRS. *Cloſe* gave Mr. *Molyneux* the following account of the effects of the thunder and lightning, which happened at her houſe at *Newforge* in the county of *Down* in *Ireland*, on the 9th of *Auguſt* 1707; ſhe obſerved that the whole day was cloſe, hot and ſultry, with little or no wind ſtirring, till towards the evening; that there was a ſmall breeze, with ſome miſling rain, that laſted about an hour; that as the air became darkened after ſun-ſet, ſhe ſaw ſeveral faint flaſhes of lightning, and heard ſome thunder-claps, as at a diſtance; that between 10 and 11 o'clock at night both were very violent and terrible, and ſo increaſed, and came on more frequent, till a little before 12 o'clock; that a flaſh of lightning, and a clap of thunder came both at the ſame time, louder and more dreadful than all the reſt, which as ſhe thought ſhook and inflamed the whole houſe; and that then perceiving a very ſtrong ſulphureous ſmell in her chamber, and feeling a groſs powder falling thick on her hands and face, as ſhe lay a bed, ſhe concluded, that part of her houſe was either

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either beaten down by the thunder, or ſet on fire by the lightning; that getting up, and calling for a candle, ſhe found her-bed-chamber full of ſmoke and duſt, as alſo the kitchen that was beneath it; that then ſhe only obſerved the looking-glaſs, which hung in her chamber, to be broken; but that next day ſhe found part of the top or cornice of the chimney that ſtood without the gabel-end of the houſe, where her chamber was, had been ſtruck off; that part of the coping of the ſplay of the gavel-end itſelf was broken down, and 12 or 16 ſhingles on the roof adjoining thereto, raiſed or ruffled, but none ſhattered or carried away; that part of the cieling in her chamber, beneath thoſe ſhingles, was forced down, and part of the plaiſter and pinning ſtones of the adjoining wall broken off and looſened, and the whole breach 16 or 20 inches broad; that at this place there was left on the wall a ſmutted ſcar or trace, as if blackened by the ſmoke of a candle, which pointed downwards, towards another place on the ſame wall, whereon a breach was made like the former, and of the ſame dimenſions, part of which was behind the place, where the looking glaſs hung; that the boards on the back of a large hair trunk, full of linen, ſtanding beneath the looking-glaſs, were forced in, and ſplintered, as by the blow of a ſmith's ſledge; that ⅔ of the linen in this trunk were pierced or cut thro', the cut appearing of a quadrangular figure, and between two or three inches over; that one end of the trunk was forced out, as the back was drove in; that at about two foot diſtance from the end of the trunk (where the floor and ſide-wall of the houſe joined) there was a ſmall breach made in the plaiſter, and a ſmall chink or creviſe to be ſeen between the ſide-board of the floor and the wall, ſo wide that a man could thruſt his fingers down; and that juſt beneath this in the kitchen, the cieling was forced down, and ſome of the lime or plaiſter of the wall broken off; that exactly under this there ſtood a large tub or wooden veſſel, incloſed with a crib of brick and lime, which was broken and ſplintered all to pieces, and moſt of the brick and lime-work round it ſcattered about the kitchen: The looking-glaſs was broken with that violence, that there was not a piece of it to be found of the bigneſs of half a crown; that ſeveral pieces of it were ſticking like hail-ſhot in the chamber door, which was of oak, as alſo on the other ſide of the room; that ſeveral of the edges and corners of ſome of the pieces of the broken glaſs were tinged of a light flame colour, as if heated in the fire; that the curtains of the bed were cut into ſeveral pieces, which was ſuppoſed to be done by the pieces of the glaſs; that ſeveral pieces of muſlin and linen

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left on a trunk, were thrown about the room, no way singed or scorched; and yet the hair on the back of the trunk, where the breach was made, was singed; that the uppermost part of the linen, within the trunk was not touched, and the lowermost parcel, consisting upwards of 350 folds of linen, was pierced thro', of which none was any ways smutted, but the uppermost fold of a table-cloth that lay over all the rest; that there was a yellow singe or stain, perceivable on some part of the damaged linen, and that the whole smelled strong of sulphur; that the glass of two windows in the bed-chamber above, and two windows in the kitchen below was shattered in such a manner, as that scarcely one whole pane was left in any of them; that the pewter, brass and iron furniture in the kitchen, were thrown down and scattered about; particularly a large gridiron about 20 pound weight, that hung upon an iron hook near the ceiling, was found lying on the floor; that a cat was found dead next morning in the kitchen, with its legs extended, as in a moving posture, and with no other sign of being hurt, than that the furr was singed a little about the setting on of the tail: It was further observable, that the wall both above and below a little window in the same gavel-end, was so shattered at the same time, that the light could be seen thro' the crevises in the wall; and that upon a large stone on the outside of the wall below this window, a mark was to be seen, as if it had been the blow of a smith's sledge, or large iron crow, whereby a splinter of the stone, weighing some pounds was broken off: Mr. *Molyneux* was further informed, that from the time of that great thunder clap, both the thunder and lightning diminished gradually, so that in an hour's time, all was still and quiet again.

An Obstruction *in the left Ventricle of the Brain, affecting the Nerves on the opposite Side; by Dr.* Archibald Adams. Phil. Transf. N° 313. p. 40.

DR. *Adams* opened a woman's skull, who died of an apoplexy, and in the left ventricle of the brain he found between four or five ounces of clotted blood, and no blood at all in the right ventricle, but every thing in its natural state; and all the nerves on the right side of the body were as strong, as any he ever observed in a sound animal, especially at their origin, and as far as he could trace them, in their course: The Dr. had been of opinion, that in which ventricle soever the obstruction happen'd to be, the nerves and muscles corresponding to that side, would be affected, but here the contrary plainly appeared; for tho'. the obstruc-

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obſtruction was in the left ventricle, yet, the ſenſe and motion of the right-ſide were entirely loſt, and the ſmall remains of either were obſervable in the left-ſide.

A Gangrene *in the* Thigh, *&c. by Mr.* Ralph Calep, *with a Remark by Mr.* Cowper. Phil. Tranſ. N° 313. p. 41.

THE wife of one *Thomas Steven* of *Maidenhead*, in the county of *Berks*, about 62 years of age, was ſeized with a fever, about the latter end of *November*, to remove which her phyſicians uſed various medicines; but in about 14 days it terminated in a tumour and numbneſs in her left foot, both which did by degrees creep up her leg, and half way up her thigh; her phyſician ordered a fomentation of *Centaur. Abſinth. Hyperic.* &c. boiled in a ſtrong *Lixivium*; and after fomenting to anoint her foot and leg with *Ol Terebinth.* wherein *Galbanum* was diſſolved; this method was daily uſed for a month, before Mr. *Calep* ſaw the patient, when he found her in the following condition; *viz.* her foot and leg cold, inſenſible, withered, and hard, as if dried in a chimney, and of a dark tawny colour; her knee ſwelled, having ſeveral large black ſpots thereon, and pitted when preſſed with the finger; there were ſeveral diſcolorations on the ſkin, half way up her thigh; the patient complained of great pain, eſpecially of nights, in her knee and thigh, yet ſhe could not feel when theſe parts were touched; her fever was now increaſed again, and ſhe was ſometimes delirious: Mr. *Calep* adviſed her friends to continue the fomentation, which they did almoſt night and day; and in a month after there was a diſcharge of a black fœtid matter, at a ſmall orifice about the middle of the inſide of her thigh, which he enlarged for the better diſcharge of the matter; he likewiſe cut into a tumour, that appeared upon the knee, but found nothing therein but wind; about a month, or five weeks after this to his great ſurpriſe, he ſaw that nature had made a perfect ſeparation of the mortifyed fleſh from the ſound, quite round the thigh, the bone of the thigh lying entirely bare upwards of four fingers breadth, and without the *Periofteum*; the fleſh above was freſh and florid, and had good white matter thereon; Mr. *Calep* perſwaded the patient to let him cut off her thigh, which he did about two fingers breadth in the ſound fleſh (becauſe the fleſh ran tapering down to the bone) whereby he made the ſtump pretty even; the bleeding was inconſiderable, becauſe nature had cloſed up the veins and arteries, which were eaten aſunder by the mortification; Mr. *Calep* dreſſed the ſtump with *Pulv. Reſtring.* mixed with *Album Ovor.* ſpread upon pled-

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pledgets, and dipped in *Ol. Terebinth.* made hot; the next dreſſings he uſed digeſtives, and performed the reſt of the cure according to the rules of art.

Mr. *Cowper* ſaw this woman ſome months after; ſhe appeared to be very decripid; he felt the ſtump thro' her cloaths, and its extremity ſeemed to be not above four or five inches below the trunk of her body: Since Mr. *Cowper* had ſo often found the large trunks of the arteries of the thighs and legs of aged people petrified, as mentioned *Phil. Tranſ.* N° 280. and moſt commonly in thoſe who have had mortifications in the legs, *&c.* he was apt to ſuſpect that the like happened in the crural artery of this woman, which like a ligature, did at length put a total ſtop to the influent blood below that ſtricture.

The Manner of making Styrax Liquida, *or* Roſa Mallas; *by Mr.* James Pettiver. Phil. Tranſ. N° 313. p. 44.

ROSA Mallas grows in the iſland *Croboſi*, at the upper extremity of the *Red Sea*, near *Cadeſi*, which is three days journey from *Suez*; it is the bark of a tree, (which is peeled off every year, and grows again) boiled in ſalt water, till it come to a conſiſtence like bird-lime, then ſeparated and put up in caſks, and imported to *Judda*, and ſo to *Mocha* in *June* and *July*, where it ſells from 60 to 120 dollars *per* barrel (each barrel containing 420 pound) according to its goodneſs; the beſt ſort is that which is freeſt from clay and dirt, which are commonly mixed therewith; and the way of trying it, is to waſh it in ſalt water, which will cleanſe it; the *Arabians* and *Turks* call it *Cotter Mija.*

The Practice *of purging and vomiting* Medicines; *by Dr.* William Cockburn. Phil. Tranſ. N° 314. p. 46.

BY Dr. *Cockburn*'s ſolution of the problem, *Phil. Tranſ.* N° 302. for determining the proper doſes of purging and vomiting medicines. 1. It is manifeſt in general, that theſe medicines operate, either by mixing with the blood, or by ſtimulating the ſtomach and guts. 2. That this their operation is more or leſs, according to the quantity and thickneſs of the blood; that is, the greater quantity and the thickeſt blood, require the greateſt doſes. And 3. That when the quantities of blood are the ſame, the doſes of purging and vomiting medicines are in a duplicate ratio of the thickneſs of the blood; as alſo that in every caſe, theſe doſes muſt be in a ratio compounded of the quantity of blood, and the ſquares of its thickneſs: Now, ſince the operations of purging and vomiting medicines, depend ſo much on the quantity and

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viſcidity of the blood, which have not hitherto been duly conſider'd it is no wonder, that the practice of phyſic in theſe evacuations has been ſo uncertain, and that the moſt ſkilful phyſicians, from their moſt accurate obſervations, could never determine the true doſes of medicines, which alter ſo much, according to the various ſubjects they work upon, as they are not acquainted with the true method of determining either the quantity of the blood, or the degrees of its thickneſs: As experience is equally the foundation and touch-ſtone of all reaſoning in phyſic, the Dr. ſubmits his ſolution to common obſervations; whether every thing, propoſed therein, does not exactly anſwer matters of fact, and the viſible operations of nature?

1. Then it plainly follows, that theſe medicines always purge beſt and moſt conſtantly in a liquid form; becauſe, they are more eaſily conveyed into the blood, and on account of their fluidity are capable of ſtimulating more parts, whatever be the way that purges and vomits operate, or what nature ſoever they are of; and this explains very eaſily a common obſervation, which has hitherto proved a great difficulty to phyſicians, concerning the different operations of the ſame medicine in different forms; *viz.* Why the infuſion of a proper quantity of a purging medicine produces its effects ſooner and more conſtantly than the like quantity of the ſame medicine in a powder; and ſtill more conſtantly in a powder, than a bolus, and ſtill ſooner and more conſtantly in a dry bolus, than in pills made into that form, with gums, that do not purge; and this difference in purging ſhall even be conſiderable, according to the ſolubility of the gums; from whence it follows, that the evacuation made by ſuch medicines, is in proportion to the quantity of thoſe medicines that happens to be diſſolved, and not to the quantity adminiſtered.

2. That purging by draughts is the beſt form, and will always have the moſt conſtant effect: The next conſideration is, that a certain quantity of any purging medicine affects us after a different manner, according to the different quantity and conſtitution of the blood, or its thickneſs; and it has been ſhewn in the ſolution of the problem, that if its thickneſs were the ſame, the doſe ſhould always be as its quantity; but the blood likewiſe differing in thickneſs, the doſes of purging and vomiting medicines muſt be augmented on account of its thickneſs; this is confirmed by daily experience, where we find, that ſick people having a manifeſt thickneſs of blood, as in dropſies, the jaundice, *&c.* take greater doſes by far, than they do at any other time, when they are not ſick, nor ailing in that manner; by a further diſquiſition

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into this matter, we find, that the doſes muſt not only be greater where the thickneſs of blood is greater, but that they muſt be increaſed in a duplicate ratio of their viſcidity; this is evident by the tables in *Caſſia*, viz. 9: 83:: 4: 33, 1 *ſcr.* 13 grains and ⅓, and therefore by alternation 9: 4:: 83: 33, 19, 13 grains and ⅓; therefore, the doſes are as the ſquares of the conſtitutions; ſo likewiſe, 9: 8 *dr.*: :16: 14 *dr.* 13 grains and ⅓, and by alternation 9: 16:: 8 *dr*: 14 *dr.* 13 grains and ⅓, *i.e.* the doſes are as the ſquares of the conſtitutions: The ſame holds true in any other conſtitution, beſides the mean; *e. g.* in the loweſt and higheſt 4: 16:: 213 grains and ⅓: 853 and ⅓: So that by this means we are not only led directly to a right uſe of theſe medicines, and enabled to find out the true cauſe, why the ordinary doſes produce ſo very different effects in different conſtitutions; but we alſo have the ſolution of this problem, viz. *The quantity of blood in any perſon being given, together with the ordinary and extraordinary effect of a purging doſe, the change of that perſon's conſtitution, and the nature of that change may be determined.*

When a doctrine is founded on a few ſimple experiments, that lead us to the cauſe of ſeveral others, that are very complex, difficult, and obſcure, that is ſufficient to prove its conformity to nature; but the Dr. intending to rectify the common practice of theſe medicines by this doctrine, frames tables of the purging and vomiting medicines in preſent uſe, better adapted to experience, than what hitherto are to be found; his method of framing theſe tables, is, by ſetting off the practicable conſtitutions in the different ages, he obſerved, to take notable quantities of purging and vomiting medicines; ſo that by comparing theſe conſtitutions with the ages, we have the different doſes in all thoſe caſes, which is all that is required for a better practice: The ages wherein theſe different doſes are taken, the Dr. finds to be four; when a perſon is about 16 or 20 years of age, and weighs about 12 ſtone; he then takes the common doſe; one of 9 years of age takes ¾ of that; one of 6 years ½, and one of 3 years ¼; moreover, it having been ſhewn in *Oecon. Anim.* p. 51. that the notable healthy conſtitutions, as alſo the notable pulſes of each of theſe are but three; if then theſe conſtitutions be as 2, 3, 4; that of the moſt fluid blood, as the firſt number, and ſo on; in that caſe, the doſe proper for any perſon will be found by multiplying the common doſe for his age into the ſquare of his conſtitution, and dividing by the ſquare of the mean conſtitution; *e. g.* if ℥j *Caſſiæ* be the common doſe, or the doſe of the mean conſtitution, *dr.* iij ℈j and 13 grains and ⅓ is the doſe of the firſt conſtitution

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and *fr.*xiv, 13 grains and ½, that of the groſſeſt or laſt conſtitution; and ſo proportionably for every medicine in all the ages, as appears by the tables: This method ſeems to anſwer ſo exactly, that nothing more ſeems neceſſary, unleſs a perſon happen to be more looſe or coſtive than ordinary (which may be known from the patient or otherwiſe) and this is to be accounted the ſame, as if he had taken an equivalent quantity of a medicine proper to produce theſe effects; and any phyſician who has conſidered this caſe in ſome people after fluxing, will allow the juſtneſs of the exception: As vomiting medicines have the ſame common doſes with purging medicines, they likewiſe admit of the like divided doſes, which may therefore be found by the ſame tables; only, as people that are more coſtive than ordinary, require a proportionably greater doſe of a purging medicine; ſo they require a conſiderably leſs doſe of a vomiting medicine, as is very well known in hot countries: It is to be obſerved, 1. That in the tables *Age* ſtands for *Quantity of Blood*; becauſe they increaſe pretty equally, and it makes the practice more eaſy to ſuch as are not accuſtomed to weights and numbers. 2. The more ſkilful are to obſerve, that the mean ages, multiplied into the mean conſtitutions, give the doſes more nicely.

Tables

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Tables shewing the Doses of purging and vomiting Medicines, according to the Solution of Dr. Cockburn's *Problem.*

	Medicines.	Ages.	Constitutions.	Doses. ℥.	ʒ.	℈. Gr.
Medicines whose common Dose is ℥j.	*Cassia Catholicon Diacarthamum Elect. lenitivum*	16	2	½	1	13 1/3
			3	8	0	0
			4	14	0	13 1/3
	Succus radic. Ir. —— Fumariæ Syrup. de Rham. —— de Pomis magis.	9	2	2	2	0
			3	6	0	0
			4	10	2	0
	——Rosar cum Helleb. Tamar. Sal cath. amar. ——Mirabile. Mann. ℥ij.	6	2	1	2	6 2/3
			3	4	0	0
			4	7	0	6 2/3
Common Dose ℥ss.	Emetica. *Vin. emetc. seu Ben. Suc. Asar. Senecionis.*	3	2	0	2	13 1/3
			3	2	0	0
			4	3	1	13 1/3
	Confectio Ham. Elect. Caryocos. Diaphœnicon	16	2	1	2	6 2/3
			3	4	0	0
			4	7	0	6 2/3
	E succo Rasar. Emet. *Syrup. emeticus.*	9	2	1	1	0
			3	3	0	0
			4	5	1	0
		6	2	0	2	13 1/3
			3	2	0	0
			4	3	1	13 1/3
		3	2	0	1	6 2/3
			3	1	0	0
			4	1	2	6 2/3

Mede-

	Medicines.	Ages	Conſtitution.	Doſes ℥.	ʒ.	Gr.
Common Doſe ʒj.	*Agaricus*	16	2	0	1	6⅔
	Aloe		3	1	0	0
	Carthamus		4	1	2	6⅔
	Ebuli ſem.					
	—— *Cortex*					
	Harmodactylus					
	Mechoacanna	9	2	0	1	0
	Pil. Aggregat.		3	0	2	5
	— *Coch. major*		4	1	1	0
	— *Fœtidæ*	6	2	0	0	13⅓
	— *ſine Quibus*		3	0	1	10
	Pulv. Diaſennæ		4	0	2	13⅓
	Rhabarbarum					
	Soldanella	3	2	0	0	6⅔
	Senna		3	0	0	15
	Turbith		4	0	1	6⅔
Common Doſe ʒſs.	*Jalapa*	16	2	0	0	13⅓
	Juli juglandis		3	0	1	10
	Lap. Lazuli		4	0	2	13⅓
	— *Armenius*	9	2	0	0	10
	Opoponax		3	0	1	2½
	Pil Coch. minor		4	0	2	0
	— *de Gut*	6	2	0	0	6⅔
	Gamandrâ		3	0	0	15
	— *Rudii*		4	0	1	6⅔
	Pul. Warvicenſ.					
	Sagapenum	3	2	0	0	3⅓
	Emet.		3	0	0	7½
	Rad. Ipecacuana.		4	0	0	13⅓
Common Doſe ʒj.	*Reſina jalappa*	16	2	0	0	8 8/9
	Extr. rhabarbari		3	0	1	0
			4	0	1	15 1/9

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	Medicines.	Ages.	Conſtitutions	Doſes. ʒ.	ȝ.	Gr.
	Pil. de Hermodactylis ȝij.	9	2	0	0	6 1/3
			3	0	1	15
	Pulv. Cornach ȝij.		4	0	1	6 1/3
	Emet.	6	2	0	0	4 4/9
	Gilla vitrioli		3	0	0	10
			4	0	1	17 7/9
			2	0	0	2
		3	3	0	0	5
			4	0	0	8 2/9
Common Doſe Gr. vj.	*Colocynthis*		2	0	0	2 2/3
	Euphorbium.	16	3	0	0	6
	Eſulæ Cortex		4	0	0	10 2/3
	Elaterium		2	0	0	2
	Gum. Guttæ	9	3	0	0	4 1/2
	Gran. Gnid.		4	0	0	8
	Ricini ſem.		2	0	0	1 1/3
	Scammon.	6	3	0	0	3
	Tr. Alhand.		4	0	0	5 1/3
	Emet.		2	0	0	2/3
	Croc. Rulandi	3	3	0	0	1 1/2
	Turbith miner.		4	0	0	2 2/3
Common Doſe Gr. iij.	Emet.		2	0	0	1 1/3
	Hep. Antomonii	16	3	0	0	3
	Vitr. Antim.		4	0	0	5 1/3
	Merc. vitæ		2	0	0	1
	Tart. emet.	9	3	0	0	2 1/4
	Merc. præc. per ſe		4	0	0	4
	—— *ſolar*	6	2	0	0	2/3
	—— *ruber*		3	0	0	1 1/2
	Hercules Bovii		4	0	0	2 2/3
			2	0	0	1/3
		3	3	0	0	3/4
			4	0	0	1 1/3

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The doſes of the above tables, ariſing from calculation, agree perfectly well with the common obſervation of the beſt authors, tho' their obſervation is very general and ill made, if we except the very firſt ſteps; for inſtance, authors of all countries, as *Engliſh*, *Dutch*, *German*, *Italian* and *French* reckon the doſes after the ſame manner; whereas, if they had been obſerved, they muſt have been as different, as the conſtitutions of men in different countries are: The defect of their obſervation is manifeſt by the diſproportioned doſes of ſome medicines, their high doſes being ſometimes double and ſometimes triple, and their low doſes in greater proportions, which is not conformable to nature; for let the low doſe be what it will the high doſe of one medicine muſt always bear the ſame proportion to the high doſe of another, as did their low doſes; *viz.* even in *Manna*, they reckon it from ʒj commonly to ʒiij and ʒiv; if it be ſaid, that the firſt doſe is the loweſt doſe that is taken by a man of a due age, it is neither true in fact, nor conformable to their own way of reckoning; for inſtance, rhubarb is ſaid to be taken from ʒj to ʒij, which is not the loweſt doſe taken by a man of a due age, nor is ʒiſs the high natural doſe; for if ʒi of *Manna* and ʒi of rhubarb be the reſpective low doſes, then ʒiv and ʒij cannot be the reſpective high doſes: As to what concerns ſome extraordinary doſes given by themſelves, and far exceeding the ordinary doſe, that is eaſily accounted for by the ſolution of the problem; there are ſeveral examples of this nature; *viz.* *Turbith* is commonly reckoned from ʒi to ʒii, yet *Margravius*, and other good authors have given it to ʒiv; ſo likewiſe *Colocynthis* from vi gr. to xii gr. yet *Fulgin.* *Fernel.* and *Duncan* ſay they have given it to ʒiſs: Authors are far from being exact; for they have only doſed theſe medicines for people of full age, but have ſaid nothing of the doſes for different ages, nor told us, at what time a man takes his higheſt doſe, or how that alters in the growth and decline of age, which is ſtill a very great difficulty for the moſt experienced phyſicians: Their general method is founded on a miſtake; their loweſt doſe being really the common doſe taken by the generality of men, which produces a great many errors in practice; this is manifeſt, in their doſing every medicine: The ſaid caſe is more manifeſt from the tables, and it is two to one, but that a phyſician either over purges or under purges any perſon in health; and if more caſes in ſickneſs are ſuppoſed, the odds will increaſe proportionably; experience exactly confirms this; for if the mean doſe be given to one of the loweſt conſtitution, and it is deſigned to purge ſeven or eight times;

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times; in that caſe, the perſon of the loweſt conſtitution is purged near twice as much, as he ought to be; and if the mean doſe be given to one of the higheſt conſtitution, he is purged but half what he ſhould be; but if the doſe of the higheſt conſtitution be given to one of the mean conſtitution, he is purged twice as much as he ought to be; and if to one of the loweſt, he is purged four times as much, or about 30 times, as we find by daily experience; but if either the quantity of blood, age or ſickneſs contribute to the error, it may prove fatal; if this conſideration were illuſtrated by a proper number of examples, we ſhould find ſome hundreds of, otherways unavoidable errors, prevented by the practice of theſe tables: Laſtly, we may by the tables eaſily account for the doſes of children, over-purging ſome people in good health, and of a competent age.

The Manner of manuring Lands *by* Sea-ſhells, *in the Counties of* Londonderry *and* Donnegall *in* Ireland; *by the* Archbiſhop *of* Dublin. Phil. Tranſ. N° 314. p. 59.

BOTH theſe counties are very mountainous, and theſe mountains are covered with boggs and heath, inſomuch, that there is little arable ground, excepting what was latterly made ſo: There are three ways of reducing heath and bog to arable land; the firſt is by cutting off the ſcurf of the ground, making up the turf ſo cut into heaps, and when the ſun has dried them, ſetting them on fire; when burnt as much as poſſible, they are ſcattered on the ground, and after plowing, it produces barley, rye, or oats, for about three years; the inconveniencies attending this method are firſt, that ſuch burning infects the air, cauſes rain and wind, and that it is not practicable in a wet ſummer; and by deſtroying the ſap of the ground and the roots of graſs, and all the other vegetables, renders it uſeleſs for ſeveral years after the third, in which it is plowed: The ſecond method is by liming; this is much better than the former, becauſe it does not depauperate the ground ſo much, laſts longer, and produces better grain, and does not as is pretended, deſtroy the graſs, if due care be taken not to over-plow it: Dung is the common manure in all other places; marle is not uſed in the north parts of *Ireland*; but about the ſea-coaſt, the great manure is ſhells; towards the eaſtern part of the bay of *Londonderry*, commonly called *Lough-foyle*, are ſeveral eminencies, that hardly appear at low-water; theſe conſiſt of ſhells of ſea-fiſh of all ſorts, particularly periwinkles, cockles, limpets, *&c.* The country people come with boats, and at low water carry loads

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of theſe ſhells away; they leave them in heaps on the ſhore, till they drain and dry; then they carry them by boat as far as the rivers will permit, and then in ſacks on horſes, perhaps for ſix or ſeven miles into the country; they allow ſometimes 40, but moſtly 80 barrels to an acre; theſe ſhells agree with boggy, heathy, clayey, wet, or ſtiff land, but not with a ſandy ſoil; they ſeem to give the land a ſort of fermentation, as yeaſt does to bread, opening and looſening the clods, and by that means making way for the roots to penetrate, and for the moiſture to enter into the fibres of the roots; this manure laſts ſo long that no one can determine the time of its duration; the reaſon of its long continuance ſeems to be this; *viz.* that the ſhells diſſolve a little every year, till they are all ſpent, which requires a conſiderable time; whereas lime, *&c.* operates in manure all at once; but it is to be obſerved, that in ſix or ſeven years the ground becomes ſo mellow, that the corn grows rank, and runs up to ſtraw to ſuch a length, that it cannot ſupport itſelf, and then the land muſt lie a year or two, that the fermentation may abate a little, and the clods harden, and then it will bear as long again, and continue to do ſo, with the like intermiſſions, for 20 or 30 years: In the years that the land is not plowed, it bears a fine graſs, mixed with abundance of daſies; and it is a pleaſant ſight to ſee a ſteep high mountain, that a few years before was all black with heath, on a ſudden look white with daſies and flowers: It refines the graſs, but makes it ſhort, tho' thick; the Archbiſhop obſerving, that this manure produced flowers in the field, made his gardener uſe theſe ſhells in his flower-garden, and he never ſaw better carnations, or fairer or larger flowers in that cold climate; beſides, it contributes to deſtroy weeds, at leaſt, it does not produce them ſo much as dung does; it likewiſe produces very good potatoes at about a foot diſtance from each other; and this is one method of reducing boggy barren land: The natives lay a little dung, or ſtraw on the land, and ſprinkle it with ſhells; ſometimes they cut the potatoes if large, and then dig trenches about ſix or ſeven foot diſtance, and throw the ſoil they take up on the potatoes, ſo as to cover them, and then fencing the plot of ground, they let them grow: If planted in *April* or *May*, they are full grown in *Auguſt*; they dig them as they have occaſion, and let them lie till next year, then dig them again, and ſo the third year; by this means, they go every year deeper into the ground, and the laſt year they dig, they pick them out as carefully as they can, that little ſeed may remain; and the fourth year they plow the ground, and ſow barley,

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ley, and the produce is very good for ſome years; ſome potatoes will grow up without hurting the barley or oats, and thoſe they dig and pick out, and the ground continues good and arable ever after. It is obſervable, that ſhells anſwer beſt in boggy ground, where the ſurface is turf; for turf is generally nothing elſe but the product of vegetables, ſuch as graſs, heath, &c. which rotting, the ſalt is waſhed away by the water, and there only remains the earthy, and eſpecially the ſulphureous parts, as appears from the inflammability of turf; now ſhells being chiefly a ſalt, it incorporates with the ſulphur of the plants, and renders them fit for the vegetation of new plants; which further appears from this; *viz.* that thoſe ſhells, which have been under the ſalt water, are much better than ſuch as have been in the earth, or lie dry on the ſtrands; upon digging a foot or two deep in the ground, for the moſt part about the bay of *Londonderry*, you find ſhells, and whole banks made up of them; but theſe, tho' more entire, than ſuch as are brought from the *Shell Iſland*, are not ſo good for manure; in a place near *New-town Lamavady*, about two miles from the ſea, there is a bed of ſhells, ſuch as lie on the ſtrand; the place was covered with a ſcurf of wet ſpouty ſoil about a foot thick; the country people uſe the ſhells, but they are not reckoned ſo good, as thoſe found in or near the ſea; the land about the ſea ſhore bears very indifferent wheat, nor will the ſhells alone anſwer the purpoſe, without ſome dung; yet this may be owing to the ignorance of the farmers, who generally underſtand nothing of wheat: Some thouſands of acres have been improved by ſhells, and what formerly was not worth a groat *per* acre, is now worth four *Shillings*; in ſeveral places the natives have thus improved the very mountains, that before were mere turf-bogs; here they meet with this inconveniency, that if the ſeaſon for plowing prove wet, their horſes ſink ſo deep in the ſoil, that they cannot plow it, eſpecially after two or three years; they commonly made lime of the ſhells formerly, and ſome do ſo ſtill; and it binds very well, and is not ſo corroſive, as lime made of ſtone; in the hiſtory of *Ceylon*, we find that they make up their land with lime of oyſter ſhells, which would be impracticable with common lime: Some years ago they made lime of the ſhells, and manured their lands with it; but a poor countryman, who out of lazineſs or poverty had not provided to make lime, threw the ſhells unburnt on his land, and his crop proved as good as his neighbours, and the ſecond and third crop better; and all took the hint, and have uſed them ſo ever ſince; where ſhells are not

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to be procured, ſea wrack, or ſand ſupply the want of them, but are not ſo good; ſea wrack laſts but three years, and ſand not much longer.

It is certain, that *Ireland* has formerly been better inhabited, than it is at preſent; mountains, that are now covered with boge, have formerly been plowed; for upon digging five or ſix foot deep, there is diſcovered a proper ſoil for vegetables, and it is found plowed into ridges and furrows; this is obſervable in the wild mountains between *Ardmagh* and *Dundalk*, where a redoubt is built, and likewiſe on the mountains of *Altmore*; the ſame has been obſerved in the counties of *Londonderry* and *Donnegal*; a plough was found in a very deep bog in the latter, and a hedge with wattles ſtanding, under a bog that was five or ſix foot deep above it; the Biſhop had ſeen the ſtump of a large tree in a bog 10 foot deep at *Caſtle-Forbes*; the trunk had been burnt, and ſome of the cinders and aſhes lay ſtill on the ſtump; he alſo ſaw large old oaks grow on land, that had the remains of ridges and furrows; and he was informed, that on the top of a high mountain in the north, there were ſtill remaining the ſtreets and veſtiges of a large town; and indeed, there are few places which do not viſibly (when the bog is removed) retain marks of the plough, which ſure, muſt prove, that the country was well inhabited; it is probable that the *Danes* firſt, and then the *Engliſh* deſtroyed the natives; and the old woods ſeem to be about 3 or 400 years ſtanding, which was near the time that *Courcey* and the *Engliſh* ſubdued the north of *Ireland*; and it is likely, made havock of the people that remained, after the *Danes* were beat out of *Ireland*.

An Account of a new Iſland *raiſed near* Sant-Erini *in the* Archipelago; *by Dr.* William Sherard. Phil. Tranſ. N° 314. p. 67.

DR. *Sherard* had an account of this new iſland from the *Engliſh* conſul at *Milo*, as follows; *viz.* that on the 12th of *May* 1707 N. S. an iſland began to riſe up, a muſket-ſhot from the iſland of *Sant-Erini*, which continually increaſing from day to day in the ſame manner, and troubling the ſea, there roſe up ſeveral rocks, that fixed themſelves to this iſland; ſo that on *June* 21, it was about half a mile in circumference.

From the *Paris Gazette April* 14th 1708. *Conſtantinople January* 4th 1708. They write from the iſland of *Sant-Erini* in the *Archipelago*, about 28 leagues north of the town of *Candia*, of the 1ſt of *December* laſt, that there ſprung up an iſland from

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from the bottom of the sea (which is very deep at that place) formed of stones, cast up by a volcano, which has often produced the same effects, and after the same manner: In the year 726, in the time of the Emperor *Leo Isauricus*, an island was formed on the north side, called the *Burnt Island*, by matter thrown up and heaped together by this volcano: In 1427 in the month of *December*, this *Burnt Island* was increased by huge rocks cast up by subterraneous fires: In 1650 in the month of *September*, the volcano again took fire, and produced the same effects, without forming any island, only a shelve or bank 10 fathoms under water: Lastly, in the month of *November* 1707, the volcano made an island, which is already two miles in circumference, and still increases by rocks and other new matter, that is thrown up; this burning was preceeded, as at all other times, by violent earthquakes, followed by a thick smoke, that rose out of the sea in the day time, and flames in the night, and accompanied with a terrible roaring under ground; there is no instance of the effects of any volcano at land, like those in the sea; and yet what renders them the more credible, is, that the island of *Sant-Erini* itself, is almost all of it composed of burnt rocks and pumice stones; it produces some sorts of grain, but has neither rivers nor springs, nor any other water, but what is preserved in cisterns.

Experiments of the luminous Qualities of Amber, Diamonds, *and* Gum Lac; *by Dr.* Wall, Phil. Trans. N° 314. p. 69.

HUMAN urine and excrement do plentifully abound in an *Oleosum* and common salt; so that the Dr. takes the artificial *Phosphorus* to be nothing else, but that animal *Oleosum* coagulated with the mineral acid of spirit of salt; which *Coagulum* is preserved, and not dissolved in water, but accended by air; these considerations made him conjecture, that amber, which he takes to be a mineral *Oleosum*, coagulated with a mineral volatile acid, might be a natural *Phosphorus*; and after making several experiments upon it, he at last found, that by gently rubbing a piece of well polished amber with his hand in the dark, it produced a light; whereupon, he procured a pretty large piece of amber, which he caused to be made long and tapering, and drawing it gently thro' his hand, which was very dry, it afforded a considerable light; he then used several kinds of soft animal substances, and found none answer so well, as wool; and now new *Phænomena* offered themselves; for upon drawing the piece of amber swiftly thro' the woolen cloth, and squeesing it

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pretty hard with his hand, a vaſt many little cracklings were heard, every one of which produced a ſmall flaſh of light; but when the amber was drawn gently and ſlightly thro' the cloth, it produced a light, but no crackling; but by holding one's finger at a little diſtance from the amber, a loud crackling is produced, with a great flaſh of lightning ſucceeding it; and what is very ſurpriſing, upon its eruption it ſtrikes the finger very ſenſibly, wherever applied, with a puſh or puff like wind; the crackling is full as loud, as that of charcoal on fire; nay, five or ſix cracklings, or more, according to the quickneſs of placing the finger, have been produced from one ſingle friction, light always ſucceeding each of them: Now the Dr. doubts not, but upon uſing a longer and larger piece of amber, both the cracklings and light would be much greater, becauſe he never found any crackling from the head of his cane, tho' a pretty large one; and it ſeems in ſome degree, to repreſent thunder and lightning; but what ſeemed more ſurpriſing was, that tho' upon friction with wool in the day time, the cracklings ſeem to be full as many, and as large; yet by all the trials he made, there appeared but very little light, even in the darkeſt room; and the beſt time of making theſe experiments, is, when the ſun is 18 degrees below the horizon; and then, tho' the moon ſhine never ſo bright, the light is the ſame as in the darkeſt room, which made him chuſe to call it a *Noctiluca.*

From amber the Dr. was led to conſider a diamond, being electrical as well as the other; and it is alſo a natural *Phoſphorus*, or rather a *Noctiluca*, exceeding all others, and may be called a mineral *Phoſphorus*, it being as the Dr. ſuppoſes, the pureſt of all *Oleoſa*: A diamond, by an eaſy ſlight friction in the dark, with any ſoft animal ſubſtance, as the finger, woolen, ſilk, *&c.* appears in its whole body to be luminous; nay, if a perſon keeps rubbing for a little while, and then expoſes it to the eye, it will remain ſo for ſome little time; but if the ſun be 18 degrees below the horizon, and any one holds up a piece of baize or flannel ſtretched tight between both hands, at ſome diſtance from the eye, and another rubs a diamond ſwiftly and pretty hard on the other ſide of the baize or flannel, the light ſeems much more pleaſant and perfect to the eye of him that holds it, than any other way the Dr. had hitherto tried; but what ſeemed more ſurpriſing, was, that a diamond, expoſed to the open air in view of the ſky, without rubbing, gives almoſt the ſame light of itſelf, as if rubbed in a dark room; and if in the open air you put your hand, or any thing elſe, a little

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little over it, to hinder its communication with the ſky, it gives no light; and the Dr. tried all or moſt of the other precious ſtones, but could find no ſuch phænomenon in any of them; all theſe experiments were made at the latter end of *May* and beginning of *June*, and therefore, he cannot pretend to account for the *Phænomena*, that may attend experiments made while the ſun is on the other ſide of the equator: There are ſome other bodies that afford light, and perhaps, many more remain yet undiſcovered; but, he is well aſſured, that all, or moſt of the bodies, which have an electricity, yield light; for, he ſuppoſes, that it is the light which is in them, that is the cauſe of their being electrical; yet this electricity never ſhews itſelf without friction; if you rub any body, that has an electricity, and apply it near to ſome light bodies, as particularly very thin ſlices of cork, it will put them into a very great agitation, and make them ſeem to the eye, as if hanging at the body by a fine hair: Jet ſeems to the Dr. to be a kind of black amber, having moſt of the properties thereof, but not ſo perfect and pure.

Another natural *Phoſphorus*, or *Noctiluca*, endued with a luminous quality, is gum lac; being no other than a vegetable *Oleoſum*, coagulated with an animal volatile acid; ſealing wax, which is compoſed of gum lac and cinnabar, the cinnabar no ways impeding, but rather promoting its luminous quality; for the Dr. cauſed long taper rolls to be made up of lac alone, and of pure red ſealing wax, both being well poliſhed; the ſealing wax upon friction, ſeemed to emit its crackling, and light ſooner than the lac which he imputed to the cinnabar's conſtringing the parts; tho' he takes lac by itſelf, to have the greateſt electricity, both having all, or moſt of the properties of amber; and by all the trials the Dr. made of lac and ſealing wax, he found that tho' the cracklings are as plentiful in the day-time, as when the ſun is down, yet, in the darkeſt places, he could diſcover but a little appearance of light: Piſmires alone in the animal kingdom, afford a volatile acid, and in the *Eaſt-Indies* there is a large kind of them, that live on the ſap of certain plants, yielding both a gum and a colour; and this ſap paſſing thro' the bodies of theſe inſects, is by their acid ſpirit converted into an animal nature; which is the reaſon that the colour extracted from gum lac, (which is nothing elſe but the excrement of theſe animals) is almoſt as good and full as laſting a colour, as is made from cochineel; and the Dr. was more confirmed in his opinion, becauſe, he knew of an artificial way of converting vegetable colours into an animal nature, very much like this, by

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by which the colours are made more agreeable and permanent: After the ſame manner, the remaining gum, which is an *Oleoſum*, being digeſted, and paſſing thro' the bodies of theſe animals, is by their volatile acid converted into a vegetable animal *Phoſphorus*, or *Noctiluca*; the artificial *Phoſphorus* is a mineral animal *Phoſphorus*, whereas, he takes the others to be altogether mineral.

The giving Motion to Bodies included in a Glaſs, *by the approach of the* Finger *near its outſide; with other Experiments on the Effluvia of* Glaſs; *by Mr.* Francis Hauksbee. Phil. Tranſ. N° 315. p. 82.

IT was obſervable, that after the motion and attrition had been continued about two or three minutes, and then ceaſing, the threads within the glaſs ſeemed to hang in a careleſs poſition, and were not inſtantaneouſly erected, but in about three or four ſeconds of time they became erect, every way towards the circumference of the glaſs, and ſeemingly with ſo much eagerneſs, that a motion of the glaſs alone would give them no great diſorder; but what was moſt ſurpriſing was, to ſee a motion given them, by the approach of one's hand, finger, or any other body, at more than three inches diſtance from the external ſurface of the glaſs, notwithſtanding the threads within did not touch the internal ſurface: And it was further obſervable, that after every repetition of the motion of the wheel, and a new attrition of the glaſs, the diſtance, at which the threads might be moved, ſeemed to be increaſed; and Mr. *Hauksbee* afterwards found, that the threads would have a remarkable motion given them, by blowing towards the glaſs at three or four foot diſtance; by which means the air was put into motion, and conſequently, the effluvia of glaſs were ſo too; at another time, ſuddenly clapping his ſpread hands on the upper and lower parts of the globe, there was ſuch a violent agitation of the threads within the glaſs, as was very ſurpriſing, and which continued for ſome time: In the experiment, where the directed threads on the outſide of the glaſs would fly, the approach of any thing held near them, it ſeemed to Mr. *Hauksbee*, that the parts of the effluvia were ſtiff, and continued ſo that when any part of them is puſhed, all the parts in the ſame line ſuffer the ſame diſorder; ſo likewiſe in the above experiment, allowing a continuity of parts, the effluvia within, and thoſe without, are continued (for they are both produced by the ſame attrition) ſo that when the effluvia are puſhed or diſturbed, the glaſs without theſe within, in the

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the ſame direction, are ſo too, and conſequently the threads which are upheld and directed by them; the effluvia ariſing from the glaſs, ſeem to be nothing elſe but parts of the ſame body emitted from it by rubbing; therefore he ſuppoſes, can be no impediment to the motion of its own effluvia; for otherwiſe he does not ſee, how the effluvia within can be produced by an attrition without; and for a further confirmation, that the effluvia of glaſs do not act, but by a continuity of parts, the following experiments may ſerve.

Exp. I. Mr. *Hauksbee* took a piece of braſs-leaf, and laying it between two pieces of wood about an inch thick, and the ſame diſtance aſunder, he applied a tube well rubbed to attract the braſs, as near as the wood would permit, but without giving it any manner of motion; as ſoon as the wood was removed, and the continuity of its ſphere reſtored, the braſs-leaf was very vigorouſly attracted, without any freſh attrition, which he thought proved very plainly, that the action of the effluvia is deſtroyed, or at leaſt in a great meaſure ſo, if its parts are diſcontinued by the interpoſition of any thing; nay, Mr. *Hauksbee* tried, by holding the tube in ſuch a manner, that its ſphere might meet with no interruption from the wood, in its circle round the axis of the glaſs, yet this would exhibit nothing neither; by which he found, that if the parts of the effluvia are in a manner interrupted, their action is deſtroyed, or at leaſt greatly impaired.

Exp. II. After the tube had undergone a freſh attrition, and the braſs-leaf was ſcattered on the table, as uſual; if a piece of paper were held in ſuch a manner, as to touch the upper part of the tube, it would not attract at all, tho' brought very near; but as ſoon as the paper was removed, it recovered its ſphere of activity, which was very ſenſible, by giving a briſk motion to thoſe bodies, which a little before were at reſt; and it was obſerved in the experiment for producing light by the effluvia of the external glaſs falling on the internal exhauſted glaſs in motion; that after the motions ceaſed, it was but drawing one's hand near the ſurface of the outer glaſs, to produce a light in the inner one; whence by theſe experiments, it is plain, that the effluvia within the glaſs were puſhed more vigorouſly on the inner glaſs, by the approach of the hand without, otherwiſe no light would have enſued; and farther to prove the ſtiffneſs, or continuity of the effluvia, it is obſervable, that when a piece of braſs-leaf is hunted about a room, that the braſs ſwims or floats on the ſurface of the effluvia, and as theſe are more or leſs exerted, ſo the

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braſs keeps its diſtance from them, nor will it by any means be ſuffered to ſink within their ſphere, unleſs it meets with a body in its way, and then it is attracted, and returns again ſeveral times, with a great ſwiftneſs.

Exp. III. Mr. *Hauksbee* corked up one extremity of a glaſs tube, and pouring in at the other dry writing ſand, till it was near full, the attrition was made, and when held towards the pieces of braſs, as uſual, there was no motion, till it arrived within an inch or thereabouts of them; and in ſeveral trials the ſucceſs was much the ſame; and if at the ſame time the ſand were ſuddenly thrown out, the tube would attract the ſame bodies at double or triple the above-mentioned diſtance, without any freſh attrition; which plainly ſhews, tho' the tube will attract, when brought near, yet the included body is a ſenſible impediment to the exerting its activity without; the unſucceſsfulneſs of a former experiment of Mr. *Hauksbee*'s, to attract bodies with a tube exhauſted of its air, ſeems to conclude, there being no air within to convey the effluvia from its body, that the continuity of their parts is interrupted.

Experiments, ſhewing Electricity *and* Light *produceable on the Attrition of ſeveral* Bodies; *by the Same.* Phil. Tranſ. N° 315. p. 87.

MR. *Hauksbee* cauſed a piece of wood to be turned into a cylinder, about four inches in diameter, and three in length; this being fixed on an axis, he melted about a pound and a half of the beſt ſealing-wax, and plunging the cylinder into it, when fluid, he kept it moving round, till it had got a coat of wax, about half an inch thick on its ſurface; when it was perfectly cold, he placed the cylinder on the machine, which gave motion to it by a large wheel, as mentioned in a former experiment; after the motion and attrition had been continued for ſome ſmall time, Mr. *Hauksbee* held the loop of threads over the cylinder, and they were attracted and directed towards its center, as in the like experiment made with the glaſs-globe, and the threads, whilſt they continued directed, would fly the approach of the finger; and thus in all reſpects, the effluvia of wax ſeem very agreeable to thoſe produceable on the attrition of glaſs; for, upon rubbing a ſtick of the above-mentioned wax, the braſs-leaf would be attracted, and return with great velocity, and ſometimes a piece of the ſame braſs might be carried all about a room, ſeemingly riding or floating on the ſurface of its effluvia; in ſhort, Mr. *Hauksbee* found no diffe-

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difference in the laws of the several effluvia, only those of glass seemed to be much the strongest, and to act with the greatest vigour; these experiments Mr. *Hauksbee* made in the day time: Upon the approach of night, he caused the same motion to be given the wax cylinder, to see what light might be produced on its attrition; he applied some clean new flannel thereto, but he could discover little or no light; yet afterwards, upon holding his naked hand as usual on the glass-globe, a considerable light appeared, tho' only where the attrition was made, nor would it continue any longer than the motion; he tried if a light would be communicated to one's finger, when brought near it, as in the experiment of the above-mentioned glass, but he could obtain no such appearance without touching it; and this in a great measure shews the weakness of its effluvia; he likewise tried what light might be produced from it, by giving it motion *in Vacuo*; and tho' he was forced to use flannel there, yet a very distinguishing light appeared on each arm of the brass spring, that gently embraced it; and Mr. *Hauksbee* was persuaded that if his hand could be made use of to rub the wax in such a medium, the light would have been much greater; for the light produced, upon the attrition of the flannel on the wax *in Vacuo*, was rather better than that, which was produced upon the attrition of it with the naked hand in the open air: From all which experiments it appears, that the largeness or smallness of the light, or attraction, produceable from bodies by attrition, proceeds from the number and strength of their respective effluvia, and so of all bodies reciprocally, falling under the same class; now whether these several *Phænomena* may be attributed to the quality of the lac, or vermillion (of which wax is compounded) or, whether the admixture of both these bodies is absolutely necessary in the production of these appearances, is worthy enquiry.

Mr. *Hauksbee* caused two wooden cylinders to be turned of the same dimensions, as mentioned in the experiment of the sealing-wax; and in the same manner, he coated their external surfaces, the one with melted sulphur, and the other with colophony, or rosin mixed with brick-dust (put into it on purpose to bind and make it the more hard) and first he fixed the cylinder, which was coated with the melted flowers of sulphur, in order to give it motion, as usual; and after holding his hand upon it for a little while, he caused the motion to stop, then bringing near it the hoop with the threads, as mentioned in former experiments; the threads were attracted and directed towards its center, but nothing so strongly, as to the sealing-wax; and upon several

trials the ſucceſs was much the ſame; then he tried the roſin in the ſame manner, and found its electricity much ſtronger than that of the former; for, the threads were attracted towards its center, with ſeemingly greater vigour, than towards that of the ſealing wax; but the roſin at that time was not quite cold; in both theſe experiments, the threads would fly the approach of one's finger; but if ſealing-wax, or amber were held near them, they would very eagerly fly and adhere to them, without being rubbed, and this Mr. *Hauksbee* never obſerved before; he farther obſerved, that the roſin while warm, would without any attrition, attract braſs-leaf at the diſtance of an inch or two; but next day, when he repeated the experiment, its electricity as well as that of the ſulphur, was inconſiderable; at night he tried what light theſe bodies would yield on their attrition in the dark; but he could produce none from the roſin, and indeed but very little from the ſulphur, and that not with his hand, but by holding the extremities of his nails very hard to it, while it was in motion; he likewiſe tried whether the ſulphur would emit any light *in Vacuo*, by its attrition in the dark, but he could diſcover none; the moſt ſurpriſing experiments of all were the following; he took the glaſs-globe that he uſed in ſhewing the experiment of the included threads, which would point every way from the center to the circumference, upon an attrition given it, and in that ſtate a motion might be imparted to thoſe threads, by the approach of one's hand near its outſide; but this proceeded from the effluvia of its own body exerted by attrition which is not ſo ſurpriſing; but that thoſe threads contained in the ſame globe, ſhould have motion given them by the effluvia of an heterogeneous body ſeparate from it, and the globe at the ſame time have no manner of motion, or attrition given it, was very ſurpriſing; for, when he had rubbed ſealing-wax near the outſide of the globe, the threads within would have motion given them in a very odd manner, tho' the wax were about three or four inches from the glaſs; he found that the like might be performed by a rubbed glaſs tube, or by amber; and if the threads were placed in a bottle well corked up, or in any other cloſe glaſs, he ſuppoſed it would anſwer in the ſame manner.

Mr. *Hauksbee* afterwards repeated this experiment with braſs-leaf, covered with a glaſs diſh on a table; and it was obſervable, that tho' the diſh was very thick, upon holding the ſealing wax well rubbed over it, the pieces of braſs within would have a briſk motion given them, and continue therein for a conſiderable time, ere the wax would require any freſh attrition; but this appear-

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ance will not always ſucceed; for ſome time after, attempting the ſame experiment, he could by no means make it anſwer as before; the temperature of the air being then altered, its moiſt effluvia were condenſed on the glaſs, and ſo long as it remained under ſuch circumſtances, it was attempting it in vain; but he found, if the glaſs was warmed a little by the fire, or placed a while in the ſun-ſhine, or well rubbed with a warm dry linen cloth, whereby the humid effluvia might be evaporated, that then the included pieces of braſs-leaf would have as briſk a motion communicated to them, from the fricated wax, as before: Now, that the fire, ſun-ſhine, or rubbing the glaſs with a warm dry linen cloth, does not only clear it from the moiſt effluvia condenſed thereon, but likewiſe gives motion to the particles of the glaſs itſelf, which motion ſeems to produce effluvia, which in conjunction with that of the ſealing wax, facilitates its action on the ſaid bodies, Mr. *Hauksbee* concluded from the following particular, *viz.* That when he warmed the glaſs by the fire, or evaporated the humid effluvia, by any of the other methods, he found, that he could give motion to the included braſs-leaf, by only rubbing his finger on the outſide of the glaſs, without the aſſiſtance of the wax; but when the well rubbed wax was held over it, the motion of thoſe bodies would be much increaſed; and it was obſervable, that ſometimes the braſs-leaf would continue in motion, after the wax was withdrawn from it; but, if the air be naturally warm, and free from humid vapours, there needs none of the above-mentioned methods, to aſſiſt the effluvia of the wax, to give motion to the included braſs-leaf; yet at the ſame time, Mr. *Hauksbee* ſuppoſes, that the particles of the glaſs are then in a greater motion, than when the experiment will not ſucceed; what he farther obſerved was, that the effluvia of the wax may very ſenſibly be felt on the back of the hand, the wax being moved to and fro, at no great diſtance from it; as he formerly obſerved the like ſenſible ſtrokes given by the efflnvia of glaſs.

An Experiment *ſhewing the different Denſities of the* Air, *from the greateſt natural Heat, to the greateſt natural Cold, in this Climate; by the Same.* Phil. Tranſ. N° 315. p. 93.

MR. *Hauksbee* took a glaſs tube about two foot long, and near $\frac{3}{10}$ in diameter; which, at about ſix inches from one extremity, he bent into a ſyphon, as repreſented in Plate III. Fig. 5. on the furtheſt extremity from the angle, he cemented a braſs ſcrew, with a ſmall perforation therein; by which means, when he put a little mercury into the ſhorter leg, he could by declining the tube, or longeſt leg, bring it to reſt any where; as

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ſuppoſe at A A, the ſuperfluous air within, paſſing thro' the ſaid perforation; then ſcrewing a cap thereon, the mercury was detained in the ſame place, and poſſeſſed the ſpace of about ½ an inch in length; in this manner it was conveyed into a wooden trough, with a thermometer; then putting in as much warm water as would cover its ball, the ſyphon lying at bottom in an horizontal poſition, its ſhorter leg appearing above the water (which was contrived thus on purpoſe to prevent any inconveniency, that might ariſe, by the water getting into it, and to give full ſcope to the preſſure of the external air) when the ſpirits of wine had aſcended by the heat of the water into its ſmall ball at top, which Mr. *Hauksbee* took to be neceſſary, in order to make his obſervations with the greater exactneſs upon its deſcent; ſuppoſing, by the time it ſhould fall to the degree deſigned to begin at, that the ſpirits in the ball would have received an equal degree of heat in all their parts; accordingly, he began his obſervations, when it had deſcended to 130 degrees above the freezing point; at which time he found, that the length of the column of air, from the cloſe extremity of the ſyphon, to the neareſt ſurface of the mercury, was juſt 144 tenths of an inch; after the ſpirits had deſcended 10 degrees lower, the air, which before poſſeſſed 144 parts, was now ſhort of it one part; and ſo on ſucceſſively, at every 10 degrees deſcent of the ſpirits, the column of the included air was leſſened in length exactly a tenth part; when it had deſcended to 30 degrees above the freezing point, the air was found only to poſſeſs 134 of the above-mentioned parts; ſo that from hence, it will be eaſy to conclude, that at the freezing point, the air in the ſyphon would be reduced to three tenths leſs than the laſt obſervation; and conſequently, at 50 degrees below the freezing point (which Mr. *Hauksbee* was informed is the greateſt degree of cold, that has happened in our climate) it would be reduced to 126 parts of the whole, and in that ſtate be one eight part more denſe than when at the greateſt degree of our natural heat; and the reaſon why he could not prove this laſter part by experiment was, that when he came to expoſe the thermometer and ſyphon to the open air, or to the freezing mixture, the ſyphon would preſently receive the impreſſion of the cold, and the air contained therein be conſiderably contracted, before the thermometer would give any ſign of ſuch alteration; but ſeeing the former part of the experiment ſucceeded ſo exactly regular, he thinks there can be no doubt of the truth of the whole calculation: This experiment was made *February* the 11th, 1708, the mercury in the barometer ſtanding at the ſame time at 30 inches.

A Table

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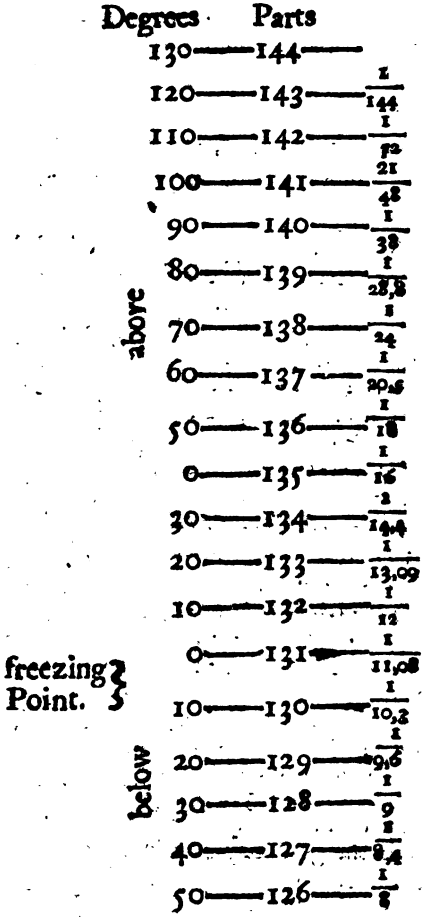
A Table of the different Degrees of the Denſity of the Air, at every 10 Degrees, from 130 Degrees above the freezing Point, to 50 Degrees below it.



This

This table shews the difference of the density of the air at every ten degrees, from 130 above the freezing point, to 50 below it; *e. g.* supposing the spirits in the thermometer should stand at 40 degrees above the freezing point, you find right against it in the third column $\frac{1}{16}$; the state of the air being then so much more dense, than when the spirit is elevated to 133 degrees; and so of all the rest: The second column shews the extent of the air, at the several stations, from the greatest heat to the greatest cold.

The Laws *of* Attraction *and other* Physical Principles; *by Mr.* John Keill. Phil. Trans. N° 315. p. 97. *Translated from the* Latin.

THE three following principles are to be laid down, as the foundation of all physics; *viz.* 1. A *Vacuum.* 2. The divisibility of quantity *in infinitum.* 3. The attraction of matter. That there is a *Vacuum* is plain from the motion of bodies; Geometricians demonstrate the divisibility of quantity from the nature of continued quantity; and experience confirms that matter has an attractive force; from the two first principles follows,

Theorem 1. *Any Particle of Matter, however small, may fill a space however large, in such a manner, as that the diameters of all the pores and* Meatus's *therein may be less than a given right line; or that the distances of the particles from each other may be less than a given right line.*

Theorem 2. *Two bodies may be given of equal bulk, however unequal in weight and density* (i. e. *quantity of matter*) *the sums of whose* Meatus's *or pores may also approach to a ratio of equality.*

Let there be, for instance, a cubic inch of gold, and another of air; tho' the quantity of matter in the cube of gold exceed 20000 times that in the cube of air; yet it is possible that the vacuities in the former may be almost equal to those in the latter; *viz.* that the vacuities in the gold may be to the vacuities in the air; as 999999 to 1000000.

Theor. 3. *The particles, which constitute water, air, or such like fluids, if they touch each other, are not absolutely solid, but consist of other particles, that contain* Meatus's *and pores.*

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The minutest and absolutely solid particles of bodies, that is, such as have no vacuities at all, may be called particles of the first composition; the *Molecul*æ arising from the coalescence of several of these particles may be denominated particles of the second composition; and again the masses made up of several of these *Molecul*æ, may be called particles of the third composition; and so on, till at length we come to particles which constitute the ultimate composition of bodies, and into which they may be ultimately resolved: That matter is endued with an attractive force, whereby its particles mutually attract each other, Sir *Isaac Newton* first deduced from the *Phænomena*; this attraction in a given quantity of matter, at different distances, is reciprocally proportional to the squares of these distances; from whence arises that force we call gravity, whereby all terrestrial bodies tend towards the earth in a right line, and the weight of bodies is always proportional to the quantity of matter they contain; from this attractive force Sir *Isaac* in a very beautiful manner, explained all the motions of the planets, and the appearing of comets, and happily perfected physical astronomy: After repeated experiments, Mr. *Keill* observed, that from this attractive force, several *Phænomena* might be accounted for.

Theor. 4. *Besides that attractive force, by which both planets and comets are retained in their orbits, there is likewise another power in matter, whereby all its particles do mutually attract, and are mutually attracted by each other; which power decreases in a greater* Ratio, *than the duplicate* Ratio *of the increase of the distances.*

This theorem may be proved by several experiments; but it does not yet sowell appear by experiments, whether the ratio, by which this power decreases (as the particles recede from each other) be in a triplicate, quadruplicate, or any other ratio of the increase of the distances.

Theor. 5. *If a body consist of particles, each of which have an attractive force, decreasing in a triplicate, or more than triplicate* Ratio *of the distances, the force by which a corpuscle is attracted by that body, in the points of contact, or at an infinitely small distance therefrom, will be infinitely greater than if that corpuscle were placed at a given distance from the said body.* Vide Princip. Newtoni. Prop. 80, 91.

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Theor. 6. *From the same* Data, *it follows, if that attractive force, at a given distance, have a finite* Ratio *to gravity, that in the points of contact, or at an infinitely small distance, it will be infinitely greater than the force of gravity.*

Theor. 7. *But if the attractive force of bodies in the points of contact have a finite* Ratio *to gravity, it is, at all assignable distances infinitely less than the force of gravity, and consequently vanishes.*

Theor. 8. *The attractive force, which each particle of matter exerts, in the point of contact, exceeds almost immensely the force of gravity; yet is not infinitely greater than it, and consequently, at a given distance, that attractive force will vanish.*

Therefore, this power, which is superadded to matter, diffuses itself but to exceeding small distances, and at greater distances is none at all; from whence the motions of the heavenly bodies (that are at great distances from each other) are no ways disturbed by this attractive force, but move continually in the same manner, as if these bodies had no such force at all.

Theor. 9. *If any corpuscle be in contact with a body, the force by which that corpuscle is attracted, that is, the force by which it coheres with that body, will be proportional to the quantity of contact; for the parts more remote from the contact, contribute nothing to the cohesion.*

Therefore, according to the various contact of particles, various degrees of cohesion arise; and the force of cohesion is greatest, when the superficies, wherein bodies touch each other, are planes; in which case, *cæteris paribus*, the force with which a corpuscle coheres with other corpuscles, will be, as the parts of the superficies that touch each other; hence appears the reason, why two marbles exactly polished, and touching each other in their plain superficies, cannot be separated, but by a weight that far exceeds the gravity of the incumbent atmosphere; hence likewise may be given the solution of that noted problem, the cohesion of matter.

Theor. 10. *Those corpuscles are most easily separated from each other, which have the fewest and smallest points of contact with*

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with other corpuſcles, as is the caſe in ſpherical corpuſcles infinitely ſmall. Hence fluidity is accounted for.

Theor. 11. *The force whereby any corpuſcle is attracted towards another body very near it, does not change its quantity, whether the matter of the attracting body be increaſed or diminiſhed, the denſity of the body, and the diſtance of the corpuſcle remaining the ſame.*

For, ſince the attractive force of particles are diffuſed but to very ſmall diſtances; it is plain, that the more remote particles at C, D, and E. Plate III. Fig. 6. contribute nothing to attract the corpuſcle A; therefore, the corpuſcle will be attracted with the ſame force towards B, whether theſe be preſent or removed, or whether others be added thereto.

Theor. 12. *If the contexture of any body be ſuch, as that the particles of the laſt compoſition ſhould by ſome external force (ſuch as the preſſure of a weight, or the ſtroke of any other body) be removed a little from their primogenial contacts, but ſo as not to acquire new contacts; the particles mutually attracting each other will ſoon return to their primogenial contacts; and the ſame contacts and poſitions of the particles that conſtitute any body, being reſtored, there will alſo be a reſtitution of the ſame figure of that body; conſequently, bodies may by their attractive force again recover their priſtine figures.*

Hence we may account for elaſticity; for, as bodies impinging on each other, do by their elaſtic force, recede from each other, as Mr. *Keill* demonſtrates in his *Phyſical Lectures*, ſo the reſilition of bodies from each other ſhould ariſe from their attracting force.

Theor. 13. *But if the texture of a body be ſuch, as that its particles, when removed from their primogenial contacts by a force impreſſed upon them, ſhould immediately run into others of the ſame degree, that body will not return into its priſtine figure.* Hence appears the nature of that contexture, which conſtitutes ſoft bodies.

Theor. 14. *The particles of matter, according to their different ſtructure and compoſition, will be endued with different attractive forces; for inſtance, the attraction will not be ſo ſtrong, when a particle of a given magnitude has ſeveral pores, as when it is entirely ſolid, and without any.*

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Theor. 15. *The attractive forces of particles perfectly solid do very much depend upon their figure.*

For should any small particle of matter be formed into a circular *Lamina* of an indefinitely small thickness, and a corpuscle be placed in a right-line passing thro' the center, perpendicular to the plane of the circle, and the distance of the corpuscle be equal to $\frac{1}{10}$ of the semi-diameter of the circle, the force with which the corpuscle is attracted, will be 30 times less, than if the attracting matter coalesced into a sphere, and the power of the whole particle exerted itself from one physical point; and the same circular *Lamella* more strongly attracts the corpuscle, than another particle of the same weight does, formed into a slender and oblong cylinder.

Theor. 16. *Salts are bodies whose particles of the last composition are endued with a great attractive force, tho' there are several pores interspersed between them, that are pervious to the particles of water of the last composition, which being therefore, strongly attracted by the saline particles, do violently rush upon them, and disjoin them from their mutual contact, and dissolve the cohesion of the salts.*

Theor. 17. *If two corpuscles mutually tend towards each other with attracting forces decreasing in a triplicate, or more than triplicate* Ratio *of their distances, the velocity of their mutual impulse will be infinitely greater than at a given distance.* Vide Princip. Newtoni. Prop. 39.

Theor. 18. *The magnitude of a body heavier than water, may be so far diminished, as at length to remain suspended therein, and not descend by its proper gravity.*

Hence appears the reason, why saline, metalline, and other such like particles, reduced to the smallest parts, remain suspended in their *Menstrua*.

Theor. 19. *Greater bodies do mutually tend towards each other with less velocity than smaller bodies.*

For the force, with which the bodies A and B, Plate III. Fig. 7. mutually tend towards each other, is principally only in the nearest particles, whilst the forces of the more remote are none at all; therefore, a greater force is not applied to move the bodies A and B, than the particles *e* and *d*; but the velocity of bodies mov'd by the same force are reciprocally proportional to the bodies themselves; consequently, the velocity, with which the body A tends

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tends towards B will be to the velocity, with which the particle *c*, ſeparated from the body, would tend towards the ſame body B; as the particle *c* is to the body A; therefore the velocity of the body A is far leſs than that of the particle *c*, ſeparated therefrom, would be; hence it is that the motion of great bodies is naturally ſo languid and ſlow, as to be commonly retarded by the circumambient fluid, and other circumjacent bodies, whilſt the ſmalleſt corpuſcles are vigorous, and ſeveral effects are produced by them; ſo much greater is the energy in ſmaller, than in greater bodies: From hence appears the reaſon of that chemical *Axiom*; viz. *That ſalts do not act till diſſolved.*

Theor. 20. *Two corpuſcles that do not touch, may be placed ſo near each other, that the force with which they tend towards each other, ſhall far exceed that of gravity.*

Theor. 21. *If a corpuſcle, placed in a fluid be on all hands equally attracted by the circumambient particles, there will be no motion of that corpuſcle; but if it be attracted more by ſome particles, and leſs by others, it will tend to that part, where the attraction is greater, and the motion produced will correſpond to the inequality of the attraction: viz. the motion will be greater in a greater, and leſs in a leſs inequality.*

Theor. 22. *Corpuſcles ſwimming in a fluid, and attracting each other more than they attract the intermediate particles of the fluid, will drive away the particles of the fluid and approach each other, with that force, by which their mutual attraction exceeds the attraction of the particles of the fluid.*

Theor. 23. *If any body be placed in a fluid, whoſe particles attract thoſe of the fluid more than the ſaid particles are attracted by each other, and there be a great many pores in the body, pervious to the particles of the fluid, that fluid will ſoon diffuſe itſelf thro' theſe pores; and if the cohefion of the parts of the body be not ſo compact but that it may be overcome by the* Impetus *of the ruſhing particles of the fluid, there will hence ariſe a ſolution of the immerſed body.*

Hence there are three things requiſite to make a menſtruum fit to diſſolve a given body; *viz.* 1. That the parts of the body attract the particles of the menſtruum more, than the ſaid particles are attracted by each other. 2. That the body have pores, open and pervious to the particles of the menſtruum. 3. That the cohefion of the particles, which conſtitute the body, be not ſo great, as that it may not be overcome by the impetus of the ruſhing particles of the menſtruum; hence it likewiſe appears, that the particles of which ſpirits of wine conſiſt, are attracted more

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more by each other, than by the particles of the ſaline body immerſed therein.

Theor. 24. *If corpuſcles, ſwimming in a fluid, and tending towards each other, be elaſtic, after their concourſe, they will mutually recede from each other, and then again ſtriking upon other corpuſcles, they will be reflected a ſecond time; whence there will ariſe innumerable conflicts with, and continual reſilitions from other corpuſcles; and by their attractive force, their velocity will be continually encreaſed, and there will be a ſenſible inteſtine motion of the parts; but according as the mutual attraction of the corpuſcles is ſtronger, or weaker, and according to their different elaſticity, theſe motions will be various, and become ſenſible in different degrees and at different times.*

Theor. 25. *If corpuſcles, attracting each other, mutually touch, no motion will enſue; for they cannot approach nearer; if placed at a very ſmall diſtance from each other, there will be a motion; but if at a greater, they will attract each other with no greater force, than they attract the intermediate particles of the fluid; and therefore no motion will be produced.*

On theſe principles all the *Phænomena* of fermentation and effervescence depend; and hence appears the reaſon, why oil of vitriol, into which a little water is put, has an ebullition and effervescence; for the ſaline particles are, upon pouring in of the water forced from their mutual contact; whence neceſſarily a motion ariſes, ſince they attract each other more than they attract the particles of the water, and are not equally attracted on all hands: Hence alſo appears the reaſon, why ſo great an ebullition is produced, upon throwing into the ſaid mixture the filings of ſteel; for the particles of the ſteel have a great elaſticity, whence a ſtrong reflection or reſilition ariſes; hence alſo the reaſon may be aſſigned, why ſome *Menſtrua*, if diluted with water, act with greater violence upon, and ſooner diſſolve any body.

Theor. 26. *If corpuſcles, attracting each other have no elaſticity, they will not be reflected from each other but form a congeries or moleculæ of particles, whence a coagulum will ariſe; and if the gravity of the ſaid congeries of particles exceed that of the fluid, a precipitation will alſo enſue; which may likewiſe ariſe from the increaſe, or diminution of the gravity of the* Menſtruum, *wherein the corpuſcles ſwim.*

Theor. 27. *If the figure of corpuſcles attracting each other, and ſwimming in a fluid, be ſuch, as to have a greater attraction, as alſo a larger contact in ſome given parts, than in others, theſe corpuſcles will unite*

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unite into bodies of given figures; and hence cryſtallizationi will ariſe, and the figures of the component corpuſcles may be determined by geometry, from the given figure of the cryſtal.

Theor. 28. *If corpuſcles be attracted more by the particles of a fluid, than by each other; they will fly as it were, and recede from each other, and be ſoon diffuſed thro' the whole fluid.*

Theor. 29. *If any corpuſcle interpoſe between two particles of a fluid, whoſe two oppoſite ſuperficies have the greateſt attractive forces, this intermediate corpuſcle will unite to itſelf the particles of the fluid; and many ſuch corpuſcles, diffuſed thro' the fluid, will form all its particles into a compact body, and reduce the fluid into ice.*

Theor. 30. *If any body emit a large quantity of effluvia, whoſe attractive forces are very ſtrong; when theſe effluvia approach any lighter body, their attractive forces will at length exceed the gravity of that body, and the effluvia will attract that body up towards themſelves; and ſince the effluvia are much more copious at ſmaller, than at greater diſtances from the emitting body, the light body will always be attracted towards the denſer effluvia, till at length it adhere to the emitting body: Hence a great many of the* Phænomena *of electricity may be explained.*

Perhaps ſome may object againſt this doctrine, and ſay, that if this attractive force were inherent in all matter, the more ponderous bodies, and ſuch as contain a greater quantity of matter in a given ſpace, would attract more than the leſs ponderous, which is repugnant to experience; but this objection may be eaſily anſwer'd in this manner: The particles of the laſt compoſition, (to which alone the attractive force is aſcrib'd) when plac'd cloſe to each other, may conſtitute a ponderous body, tho' of themſelves they may be more rare, than the particles of the laſt compoſition, that conſtitute a light body, being more remote from each other, and having more and larger pores: Several other *Phænomena* of nature, Mr. *Keill* thinks may be explained by the ſame principles; as the aſcent of the ſap in plants and trees; the determinate and conſtant figures of leaves and flowers, and their ſpecific virtues, *&c.* As alſo ſeveral things that daily occur in the animal oeconomy; particularly what re-

lates,

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lates to the circulation and ſecretion of the fluids, and which depend upon the ſame qualities of matter; and hence the theory of diſeaſes, and the effects of medicines are beſt inveſtigated.

Concerning the migration of Birds; *by Mr.* Derham. Phil. Tranſ. N° 315. p. 120.

WHAT Mr. *Derham* would ſuggeſt as to the migration of birds is, that the members of the Royal Society all over the kingdom, ſhould themſelves, or procure their inquiſitive friends to obſerve, and mark down the very day they firſt ſee or hear of the approach of any of the migratory birds, or birds of paſſage; and he thinks it might likewiſe be convenient to obſerve how the wind ſits at the ſame time, eſpecially, towards the ſea-coaſts; and from the ſeveral obſervations compared together, a probable conjecture might be made as to the quarter whence theſe birds come, whether from the eaſt, or any other point: The *Iynx* or *Wryneck*, which Mr. *Derham* takes to be undoubtedly a bird of paſſage, he firſt heard on the 29th of *March*, the wind being ſoutherly, and ſouth weſt, that and the preceeding day, but eaſterly before: He alſo ſaw for the firſt time the *Certhia*, or *Creeper* (which leaves *Eſſex* till the ſpring, but whether a bird of paſſage or not, Mr. *Derham* could not tell) on the 23d of *March*, the winds that day varying from S. to N. but blowing ſtrongly the preceeding day from the weſt: Now if theſe birds in the more weſterly, or any other parts, at 100, 200, or more miles diſtance, ſhould be found to come ſooner or later, we might conclude that they accordingly came from the eaſtward, or weſtward, or other point, eſpecially, if about the ſame time the winds ſeemed to favour their flight: In the year 1707 Mr. *Derham* obſerved, that the ſwallow came the 31ſt of *March*; *April* the 1ſt, the *Iynx* was firſt heard at *Upminſter*; *April* 4. he firſt eſpied the *Ruticilla* or *Redſtart*; the 5. he ſaw the *Martin*; the 6. the *Nightingale*; the 7. the *Cukow*, he was told was heard, and the 9. he heard it itſelf; the 17. he heard the *Swift* or *Black-martin* ſqueak in a hole in his houſe, where it had quietly built for ſeveral years; but it being cold weather, he did not fly abroad, till ſome days after.

Microſcopical Obſervations on red Coral; *by M.* Leewenhoeck. Phil. Tranſ. N° 316. p. 126.

M. *Leewenhoeck* had ſeveral times ſlit, both lengthwiſe and in breadth, ſeveral pieces of blood coral, that were very fair and of a ſhining redneſs; and he cut off as thin ſcaly particles

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ticles as poſſible, in order to diſcover the veſſels therein; and in doing this, he now and then fancied that he could perceive ſome very ſmall orifices of the ſaid veſſels, but ſo exceeding minute, that he could make no certain obſervations on them, tho' he could eaſily ſee that in ſuch parts, as he cut a-croſs, there ran ſuch fibres from the center to the circumference, as are found in roots; and notwithſtanding all his endeavours, he could not find any pores in them, at leaſt ſo as to determine any thing certain about them; but the coral appeared to him moſtly to conſiſt of roundiſh particles, ſuch as ſome fruits are compoſed of; but their roundneſs was ſuch, that each of them was in a manner of a different figure, as might beſt ſuit with the reſt, and ſo leave no vacuity in them; and thus the ſap, which is not in the veſſels, is conveyed from one of theſe round parts to the other, and ſo ſerve for canals: In order to account for thoſe pieces of blood-coral, that are preſerved as rarities, and reſemble little trees with their branches, faſtened to ſtones or other ſubſtances, he ſuppoſes that coral, whilſt it is growing at the bottom of the ſea, is very ſoft; and that thoſe plants or branches thereof being broken off by the coral-fiſhers, their thick extremities may accidentally fall upon a ſtone, or ſome other ſubſtance, and by reaſon of their ſoftneſs, and glutinous nature, be very eaſily faſtened to the ſtone, *&c.* M. *Leewenhoeck* had two pieces of coral, no bigger than a hen's quill, one of which he broke into ſeveral pieces, and found in three places cavities, that poſſeſſed more than half the ſpace of the coral itſelf; between thoſe cavities the parts of the coral were ſolid and cloſe; and in each of thoſe cavities was a thin membrane, that a perſon would be apt to take for a bit of a dried leaf, becauſe the long parts, that appeared in great numbers therein, ſeemed to be canals or veſſels; but upon a ſtrict examination, he judged them to be coagulated ſalt particles, and the rather, becauſe they were ſharp at both extremities: But he owns he cannot conceive, how ſuch particles ſhould be found in the middle of the coral, eſpecially, if we allow that ſubſtance to receive its nouriſhment and increaſe, in the ſame manner as other plants: For his further ſatisfaction, he took a little piece of very fine red ſhining coral, and putting it into the fire, he obſerved that a little heat cauſed the fine red to diſappear, and turn it into an aſh colour; the coral being in this condition, its ſuperficies ſtill retained the ſame ſmoothneſs, but under it the particles reſembled ribs extended lengthwiſe in the coral; and viewing it more narrowly, he obſerved that the ſaid rib-like particles compoſed a circle of round ſcales, and that ſeveral circles

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were formed by thoſe particles, till the middle point of the coral, in which there was no opening, became an oblong ſingle particle: Now having obſerved that the coral by heating, did not burſt into pieces, but was only ſplit or rent in one place, he imagined that the matter, driven out of the coral by the heat of the fire, evaporated thro' that rent; or elſe that the parts of the coral being opened by the heat, the moiſture in the internal parts might be drawn out towards the external parts; after this he put a little piece of coral into a glaſs, and the glaſs into the fire, increaſing the degrees of heat ſo faſt, till the glaſs was melted; then preſerving the matter that was extracted, as well as he could, and viewing it thro' a microſcope, he diſcovered a wateriſh moiſture, which to the naked eye ſeemed yellowiſh, and mingled with a vaſt number of ſmall particles, that made the liquor thick and turbid, as alſo with a yellowiſh oil, which where it lay thickeſt, was of a reddiſh colour: M. *Leewenhoeck* moreover took ſome other pieces of coral, and laying them upon glowing wood-coals, he put them into ſo great a heat, that their colour turned from a red to a fine white, and in that condition he threw it into ſome clear rain-water, when he obſerved that its parts were immediately ſeparated, and moſt of it in appearance turned into a white and chalky ſubſtance; and the reaſon, why all the reſt of the coral was not diſſolved, was as he ſuppoſes, becauſe a ſufficient heat could not reach all its parts; for when he took the remainder, and heated it, as he had done before, the ſame effect was likewiſe produced in that; the water wherein the coral was quenched, had not ſtood a minute, when he could perceive a ſcum or film on its ſurface, impregnated with ſalt particles, and conſiſting of ſuch a vaſt number joined together, that it was impoſſible to diſcover their figure; after the water had ſtood ſome hours, he obſerved a great many ſalt particles, and of ſuch various figures, that it was impoſſible to deſcribe them; ſome of them were clear as cryſtal, and it was a very agreeable ſight to ſee ſo many different figures of ſuch different ſhapes aud ſizes, lying together in ſuch a narrow compaſs; and as they were fine and ſhining when ſurrounded with water, almoſt all of them were no leſs dark, when the water was evaporated, and then they appeared, as if they were diſſolved inro a great many ſmall particles, ſeemingly of a whitiſh ſubſtance; at another time he imagined, that he ſaw the watery part, that lay upon or about thoſe ſalt particles, impregnated with a great number of other ſalts, much ſmaller than the former, which in evaporating the water, were coagulated upon the clear ſalts firſt men-

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mentioned, and ſo obſcured their ſhining, or tranſparency: After ſome days, decanting the water from off the whitiſh matter, and pouring freſh water thereon, he obſerved that the ſalt particles were ſtill coagulating on the ſuperficies of the water, and extracted from the coral in vaſt quantities; from hence we may conclude, that the hardneſs of coral proceeds from no other cauſe, than the great number of its fixed ſalts: Now foraſmuch, as the heat of the fire was ſufficient to deprive the coral of its red colour, as ſoon as put into it, he laid three ſmall pieces of coral in *Aqua fortis*, to try whether that would have the ſame effect; and he had no ſooner poured the *Aqua fortis* upon the coral, but the air-bubbles emitted from the ſaid coral, poſſeſſed four times the ſpace the *Aqua fortis* had done before; and moreover, the coral by reaſon of the great number of air-bubbles, that continually proceeded from it (ſome of which alſo adhered thereto) was raiſed from the bottom to the ſurface of the water, but that water was not in the leaſt tinged with red coral, but became whitiſh, which was occaſioned by the parts ſeparated from the coral; and when the *Aqua fortis* had no more power to diſſolve the coral, becauſe only a very ſmall quantity of it was poured thereon, the abovementioned diſſolved particles ſubſided to the bottom, and the ſuperficies of the *Aqua fortis* reſumed its former clearneſs; after the *Aqua fortis* had ſtood about two hours on the red coral, he took a little of that whitiſh matter that had ſubſided to the bottom of the glaſs, and putting it upon a clean glaſs-plate, he diſcovered a vaſt number of oblong particles, that appeared like the very fine hair of one's beard, he alſo took ſome of the upper part of the *Aqua fortis* that was clear, and pouring it upon a clean glaſs, he likewiſe diſcovered therein a great many oblong particles, ſuch as were mentioned before; and upon examining more narrowly into that white matter, that had ſubſided to the bottom of the glaſs, he found it was nothing other than the above-mentioned ſlender particles, ſome of which were longer than the reſt; the quantity of *Aqua fortis* not being ſufficient to diſſolve all the coral, he added a little more thereto, and then he obſerved that ſoon after, the remaining part of the coral was diſſolved, only that a very few particles, which conſiſted of much ſmaller ones (or rather thoſe ſmaller particles again coagulated) floated upon the ſurface of the water, but it was impoſſible to diſcover their figure; and then the *Aqua fortis* impregnated with the red coral was very clear, but upon viewing it thro' a microſcope, he diſcovered a vaſt number of the aboveſaid oblong particles ſtill floating

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therein; and upon placing them before a greater magnifier, he discovered such exceeding slender particles as almost escaped his sight, and which he supposes, were altogether invisible before; with this glass he discovered oblong particles, which did not only exceed the rest in length, but also in thickness, the extremities of which were obtuse; and having discovered in some few of them three distinct sides, he concluded, that they were of an hexangular figure, and consequently particles of salt-petre: From these observations, M. *Leeuwenhoeck* considered, whether all those salt particles, in which as mentioned above, he had discovered so many different figures, were not originally of the same shape, with those very slender salt particles he discovered, when he dissolved the coral in the *Aqua fortis*, notwithstanding they were 1000 times smaller, than they appeared thro' the microscope; and the difference of their figures might perhaps, only be occasioned by the accession, or coagulation of other particles, which might be greater or less in one place than in another, and accordingly, their figure and size be determined by their nearness to, or distance from each other: After this M. *Leeuwenhoeck* broke off two small pieces of red coral from a small shell he had lying by him, placing them upon a wood-coal, he made the coral red hot by blowing the flame of a wax candle thereon, and in that condition throwing it into a little clean rain water, he observed that it was immediately dissolved into a fine white matter, which soon after was covered with a scum, from time to time increasing in thickness; and about two hours after, he saw amongst the vast number of exceeding small salt particles, some of a larger size coagulated, and agreeing with the above-mentioned salt particles; in short, one would imagine, that the salt particles, separated from that small piece of coral, and coagulated in and upon the water, did all together form a larger body, than even all the parts of the coral itself could amount to.

M. *Leeuwenhoeck* being informed that a certain physician, or surgeon, used coral in his medicines, took some of the finest red coral, and putting it into a piece of post paper, he beat it with a hammer to powder; afterwards putting the powder into a clean glass, he poured fair rain-water thereon, till the particles of the coral were covered with it; then heating the said water, till it boiled about a minute, he put a little of it after it had stood some time, and was grown cold, upon the cleanest glasses he could procure, that the water being altogether evaporated, he might then discover, whether any of the salt particles were gone over to the water; but viewing it narrowly, after it was entirely evaporated,

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evaporated, he could discover nothing remarkable therein; and upon evaporating the clean rain-water, he found that there was no other difference between that, and the other water in which the powdered coral was boiled, than that there were more particles in the rain-water, than in the other; he also at several times viewed with his naked eye that water, at the bottom of which lay the boiled coral, till it was in a manner evaporated, but he could not in the least discover any salt particles therein, and moreover, the water remained very clear: In short he concluded, that it is impossible for those fixed salts, of which coral mostly consists, to be dissolved in the human body, and consequently that it is altogether useless in physic.

Some Roman Coins *found in* Yorkshire; *by Mr.* Ralph Thoresby. Phil. Trans. N° 316. p. 134.

SOME *Roman* coins were plowed up at *Cookridge*, which are a confirmation of the following conjecture; *viz.* that the Roman *Via Vicinalis* (which comes from the great military road upon *Bramham-moor*) passed from that station at *Adellocum*, (of which there is an account *Phil. Trans.* N° 282) thro' these grounds to *Ilkley*: The coins were mostly fair; the oldest was of *Domitian*, *Anno Urb. Cond.* 846, which coincides with A. D. 95; his head is surrounded with this inscription, IMPerator CAESar DOMITianus AUGustus GERmanicus, P. M. i. e. *Pontifex maximus*, TR. P. *i.e. Tribunitia potestate*, XIIII; the reverse shews he was then saluted emperor the 22d time, IMP. XXII. COS (*Consul*) XVI CENS. P. P. (*Pater Patriæ*) the *Flavian* family particularly affected the title of censors, and *Domitian* is the last emperor, who had that title on his medals; the figure upon this reverse had a helmet on the head, and a spear in the right hand.

The next was *Nerva's*. IMP. NERVA CAES. AUG. P. M. TR. P. COS. The reverse CONCORDIA EXERCITVVM. Dextræ junctæ.

The seven following were *Trajan's* but all different; IMP. CAES. NERVA TRAJANVS GERM. Reverse P. M. TR. P. COS. III. P. P. *figura stolata stans, sinistrâ Cornucopiam.*

The next had the same inscription, saving that it was in his fourth consulship, and had *Figura galeata cum hastâ*. IMP. TRA-

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TRAJANO AUG. GER. DAC. P.M. TR. P. Reverſe COS. V. PP. SPQR. (*Senatus Populuſque Romanus*) OPTIMO PRINCipi; *Pacis ſtantis Typus dextrâ facem admoventis Spoliis, ea conflagraturæ ſiniſtrâ, cornucopiam tenentis.* (*exurge*) PAX.

IMP. CAES. NER. TRAJANO. OPTIMO. AUG. GER. DACico. Reverſe P. M. TR. P. COS. VI. P. P. SPQR. *Deus Genius ſtans, dextrâ Pateram.*

IMP. TRAJANUS. AVG. GER. DAC. P. M. TR. P; the reverſe, COS. VI. SPQR. OPTIMO. PRINC. *figura ſtolata.*

IMP. TRAJANO. OPTIMO. AVG. GER. DAC P. M. TR. PP; the reverſe COS. VI. PP. SPQR. *Figura ſtolata dextrâ Caduceum, ſiniſtrâ Cornucopiam.*

IMP. TRAJANO AUG. GER. DAC. P. M. TRP. COS. VI. PP. The reverſe SPQR. OPTIMO PRINCIPI. *Columna Cochlidis* Trajani.

The reſt that were legible, were of *Hadrian*, viz.

HADRIANUS AVGVSTVS. The reverſe COS. III. *Victoria cum Palmâ.*

The other had upon the reverſe.

FELICITATI AVGVSTI. Above it the *Navis Prætoria*, and below it COS. III. P. P. All theſe were of ſilver; and there was a large one of copper of the emperor *Domitian.*

IMP. CAES. DOMIT. AVG. GERM. - - - - but the reverſe was not legible.

John Dyneley, of *Bramhope*, Eſq; had alſo three; one with FIDES EXERCITUUM, one of *Titus*'s, and one of *Trajan*'s, with *Dacia* captive under a trophy; Mr. *Thoreſby* had one, which was ſtamped upon a remarkable occaſion, and not mentioned in his edition of *Occo*, it was inſcribed round the emperor's head HADRIANUS AUG. COS. III. P. P. The reverſe

reverſe RESTITUTORI HISPANIÆ; this was upon *Hadrian*'s peaceable ſettling of affairs in *Spain*, his native country, repreſented as a woman with a branch in her right hand, to denote her fruitfulneſs, kneeling before the emperor, who kindly takes her by the hand to raiſe her up.

By theſe it appears that this ſtation flouriſhed, when the *Roman* empire was in its prime; and there being none of a later date, makes it probable, that it was deſtroyed in ſome of the inſurrections of the native *Brigantes*, about *Severus*'s time, as was conjectured from the form of the letter A in the inſcriptions on the funeral monuments *Phil. Tranſ.* N° 282.

An Account of a Storm *of* Thunder *and* Lightning; *at* Ipſwich; *by* Orlando Bridgeman; Phil. Tranſ. N° 316. p. 137.

THERE happened at *Ipſwich*, on the 16th of *July*, 1708, a violent ſtorm of thunder and lightning; about 6 o'clock at night it began to be perceived at ſome diſtance, and aroſe to the ſouthweſt; Mr. *Bridgeman* happened then to be on the higheſt eminence about *Ipſwich*, from whence he could very plainly diſtinguiſh the working of the ſtorm; the inſtant he perceived the flaſh, it ſeemed to extend itſelf like a bow, and caſt its light a conſiderable way round it; and the ſhaft of lightning did not run as uſual, in a waving angular figure, but in a ſtrait ſhaft of fire, reſembling the fuze of a bomb, directly from the cloud to the ground; and ſoon after there were two or three very great flaſhes of lightning, and the peal that ſucceeded them, was ſo very loud, and cauſed ſo great an emotion in the air, that it made the rooms ſhake, and the windows rattle, as in a very violent ſtorm of wind: Dr. *Dale* aſſured him, that the lightning ſeemed to continue for ſome conſiderable time on the ground, and that he could very ſenſibly feel its heat; the paſſage-boat was at that time coming from *Harwich*, and juſt got to the town, or very near it, when a terrible flaſh came, and killed the maſter of the veſſel and three more on board; one of them had a wound in his thigh, his breaſt was torn as if he had been whipped with wires, and his face and body were as black, as if he had been blown up with gun-powder, and he had a thouſand ſmall black ſpots about him; the maſter of the veſſel was not at all diſfigur'd, but had a wound on his ſide, that reſembled a freſh burn, and no other marks about him; the chain of his watch was melted, yet no burn could be perceived on his breeches, or cloaths; the third perſon was very much torn and ſhattered about the head, the crown of his hat was taken clear away, as if cut out, and ſeveral parcels

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parcels of his hair were driven into the ſubſtance of the hat; the fourth was very little disfigured, only he had a black ſpot on his ſide, and a ſmall wound, as if it had been made by a cauterizing iron; there were ſeveral others aboard, that were wounded and ſtunned; one *Artis* had his hair burnt cloſe to his head behind, and his peruke untouched; he had a ſcratch on his arm about four inches long, and a ſmall hurt below the elbow; he ſell that night into a violent fever, grew delirious, and was reckoned irrecoverable; whether he received any hurt on his brain, or whether the violence of the fever cauſed the delirium, could not be determined; there was no mark to be ſeen on his coat, waiſtcoat, or ſhirt, where he received the hurt on his arm; two of thoſe killed were on the outſide, and the other two under the tilt of the boat; and what was pretty remarkable, the two that were within the tilt, ſat on each ſide of a woman, who received no damage; one perſon had the ſole of his ſhoe ripped from the upper leather, without any other hurt; there was another boat that followed them, and received no damage, the maſter of which affirmed, that he ſaw the flaſh light on the bow-ſprit of the former boat, where meeting with a ſmall reſiſtance, it flew into ſmall ſtreams like a rocket, part of it into the boat, and part into the water; which no doubt, was the cauſe of the miſchief done in ſo many different parts of the boat, and does in ſome meaſure ſolve the ſeeming difficulty of the woman's receiving no damage between the two perſons that were killed.

An Account of the Storm *of* Thunder *and* Lightning *at* Colcheſter; *by Mr.* John Nelſon. Phil. Tranſ. N° 316. p. 140.

ON *Friday July* the 16th 1708, about eight o'clock at night (the greater part of the afternoon being cloudy, but more ſo towards night, with thunder at a diſtance for upwards of an hour before, and much lightning) Mr. *Nelſon* heard a thunder-clap ſo loud, as if it were cloſe by him, and at that time the thunder and lightning broke into one Mr. *King*'s houſe; beginning at the ſouth ſide thereof at the gable end, and breaking ſeveral roof tiles, and continuing its courſe perpendicular, and in a ſtraight line (the only direction that ſeems conſiſtent with ſuch a violent motion, tho' it ſeemed to be otherwiſe in the Gentlewoman's houſe in *Ireland*) it went into a lean-to, and lighting on a projecture of the wall, it entered into the beer-buttery thro' the laths, and drove a cork out of the lower tap-hole of a butt of beer; in its way it ſhivered a ſtud about three inches ſquare; ſo that one ſide remained nailed to the laths, yet not much thicker than

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thap a lath, and broke it in two; below the beam, it clave and ſplit a ſtud about four inches ſquare, for ſeveral foot downwards; this was occaſion'd by its violent grazing on the outſide, and a ſtrong ſmell of ſulphur was felt; with its violence it threw the broken wall to ſeveral roods diſtance; *Allhallow*'s church in *Colcheſter* ſuſtained alſo ſome little damage.

About the ſame time there were ſeveral boats carrying paſſengers from *Harwich* to *Ipſwich* on the *Orwell*, when the violence of the thunder and lightning kill'd four of them dead on the ſpot, made a young lad run mad, and wounded the reſt, which were twelve in number; it melted a watch and chain all to a lump; one Mr. *Holbarow* of *Colcheſter*, being a paſſenger in one of the boats, felt ſuch a ſmell of ſulphur, that he could not bear it. This was about 18 miles N. E. of *Colcheſter*; and at a mile S. E. it was not more violent then an ordinary ſtorm.

An Account of the Manuring of Land *in* Devonſhire, *with Sea-Sand, by Dr.* Bury. Phil. Tranſ. N° 316. p. 142.

THE burning of the ſurface of the land is ſo much practis'd in *Devonſhire*, that it is in other places known by the name of *Devonſhiring*; but uſed only for bad lands, and by worſe husbandmen; for it robs the ground, as the arch-biſhop of *Dublin* obſerv'd *Phil. Tranſ.* N° 313. Salt quickens dead land, and is uſed in the ſouth weſt part of that country, which would otherwiſe be the barreneſt, but is now the richeſt part thereof; they go as far as the ſea will permit them at loweſt ebb, take the ſand in bags, and carry it on horſeback 14 miles into the country, and ſpread it on the land, thereby improving it both for corn and graſs; in other parts they force their barren land, by mingling the earth with lime, and caſting it on the ground: In this they differ, that crude ſalt alone, if ſtrewed upon the ground, does not improve, but corrode it; but, lime, tho' unmingled, betters the ground; in this they agree, that they do not produce graſs fit for cutting down, but for paſture, it being ſhort and ſweet, and growing all the winter; ſo that their ſheep need not either hay or water, nor are their higheſt grounds parched by the ſun in the hotteſt ſummer.

The ſea ſalt is too ſtrong and active of itſelf, the lime has a more balſamic, and more gentle ſalt, and when regularly mixed with the other, it is thereby invigorated; how to mix them, *Glauber* directs thus; "Take quick-lime, let it ſlack by time, "without water; then take ſalt and water, mingle them toge-"ther, and make them into balls or pieces, which you pleaſe, "dry

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" dry them as you do bricks, then burn them for about two hours; " this compoſt will enrich your pooreſt land".

An Account of an Ideot *at* Oſtend, *&c. by Mr.* Claud. Amijand. Phil. Tranſ. N° 317. p. 170.

ONE that had been an ideot from his infancy, died at *Oſtend*, in the 33d year of his age, his death being preceeded with 12 days continual fever, and a conſiderable tumour, and pain about the region of the liver; for ſix weeks before his death, he ſpit or vomited blood, and had bloody ſtools: Upon opening the body a large abſceſs or impoſthume was found in each lobe of the liver; the ſtomach was exceedingly contracted and ponderous, containing nine cart-wheel nails, and ſix others of a leſſer ſize; a large and long iron ſcrew; two pair of compaſſes, the one with a circle two inches in diameter; a middle ſized key; a large iron pin, as big as one's thumb, and four inches long, with a ring at its extremity; another of braſs, but much leſs; the handle of an iron ſpring knife (ſwallowed as was ſuppoſed entire, but the ſides and the two pieces forming the ſpring, were found aſunder; tho' the pegs of the knife, tying thoſe ſeveral pieces together, were not found) the upper and lowermoſt extremity of the braſs pommel of a grate, weighing nine ounces; a broad piece of lead weighing three ounces and a half; the whole conſiſted of 28 pieces, weighing between two and three pounds; theſe were all found in a bundle, with the largeſt ends one way, and the ſmalleſt the other; the ſmall extremity of one of the large nails was bent in ſuch a manner, that it would have made a perfect circle, had not its very tip been bent back again; this extremity was forked and exceeding ſharp, as were likewiſe the extremities of the compaſſes; none of the pieces were found poliſhed, nor was the braſs or lead any ways impaired, or endamaged; but the iron pieces were exceedingly corroded, eſpecially one of the ſides of the knife, which had lain in the ſtomach about 8 months, was eaten quite thro' in two or three places, towards the end of the blade; and three or four nails were greatly corroded, as if ſome particular menſtruum, or diſſolvent had been poured upon them, whilſt all the other metals were untouched; the lead had lain in the ſtomach about eight months; and the braſs-pin above-mentioned above a twelve-month; it was very eaſy to conjecture how long thoſe different pieces of iron had been in the ſtomach, by conſidering how much one piece had ſuffered more than another: This obſervation ſeems to be inconſiſtent with the notion of ſuch as believe that oſtriches diſ-

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ſolve braſs and iron by friction only; for if it were ſo, Mr. *Amijand* ſees little reaſon why the iron legs of the compaſſes ſhould have been ſo very much worn out, and the braſs branches not in the leaſt impaired. M. *Amijand* was told by the ſurgeon that opened the body, that the ſtomach was no ways wounded or endamaged, which he does not think probable, ſeeing the patient both vomited and evacuated blood by ſtool for ſix weeks before he died; it is plain, that ſome of the pieces had paſſed the *Pylorus*, as the pegs of the knife, and perhaps ſome ſmaller pieces, than thoſe that were found in the ſtomach: This idiot from his youth accuſtomed himſelf to ſwallow large morſels, without chewing, which no doubt made the paſſage of the *Oeſophagus* wider, and diſpoſed it to give entrance to all thoſe extraneous bodies; it was alſo obſervable, that this idiot, and ſometimes madmen, was never known to ſleep a wink, tho' he was often compelled to go to bed, and had been very much harraſſed and fatigued; he always eat three times as much as any other perſon, and when furious, was quieted upon bringing him victuals.

M. *Amijand* was ſhewn a tumour the largeſt he ever ſaw; it was of a ſcirrhous nature, ariſing from the thigh bone, and tending to be ſomewhat cancerous; it firſt took its riſe about two years before, in a child 10 years old, juſt above the *Patella*, without any viſible cauſe; and notwithſtanding all poſſible care, it expanded itſelf in ſuch a manner, that it poſſeſſed the whole thigh to the very groin, being above a *Dutch* yard in circumference, and daily increaſing very much.

In the hoſpital at *Ghent* M. *Amijand* obſerved a very remarkable fracture in the interior part of the *Os ſquamoſum* of the ſcull, occaſioned by a ſplinter of a fellow ſoldier's piece burſting, which ſtruck the patient there; ſome time paſſed before the ſymptoms made a fracture ſuſpected, and obliged the making a triangular inciſion on the temporal muſcle; when a fiſſure was diſcovered, which indicated the neceſſity of the trepan; it was applied twice, the firſt not making room ſufficient to extract a large piece of the internal table, very much depreſſed; after this, all the ſymptoms diſappeared; but 12 days after the operation, rigors, cold ſweats, an intermitting pulſe, and ſome other ſigns of approaching death, made the patient's recovery deſpaired of; he died the 15th day from the operation, and about the 20th from the time of his receiving the wound; his ſcull was opened, and in it were obſerved three remarkable fiſſures; the firſt notwithſtanding the intervention of the ſagittal ſuture, had croſſed from one parietal bone to the other, as far as the coronal ſuture on the

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ſide oppoſite to the wound; another had gone croſs the coronal bone, and the third was in the parietal bone, on the ſame ſide with the wound, pretty near the *Sutura ſquamoſa*; but what was moſt remarkable was, that none of theſe fiſſures reached that, upon which the trepan had been applied; an *Empyema* was found in the *Thorax*, and a large impoſthume in the liver.

An Account of the new Philippine Iſlands; *by* Father Paul Clain *and* Father Le Gobien. Phil. Tranſ. N° 317. p. 189.

THE *Pintados* are large iſlands ſeparated from each other by arms of the ſea, whoſe ebbing and flowing render their navigation difficult and dangerous: At the town of *Guivam* in the iſle of *Samal*, the laſt and moſt ſouthern of the eaſtern *Pintados*, we found 29 *Palaos*, or inhabitants of certain new diſcovered iſlands; the eaſterly winds, that blow on theſe ſeas from *December* to *May*, had driven them 300 leagues from their own iſlands to the ſaid town, where they arrived in two ſmall veſſels, called *Paraos*, of which adventure we received the following account: About 35 perſons imbarked, in order to paſs over to one of the neighbouring iſlands, when there aroſe a very ſtrong wind, that forced them out into the main ſea, ſo that they could not gain the iſland they deſigned for, nor any of the neighbouring iſlands; they were driven before the wind for 70 days together, without being able to make any land; at length, they found themſelves in ſight of the town of *Guivam* in the iſle of *Samal*; a *Guivameſe*, that was then on the ſhore, perceiving them, and judging by the make and ſmallneſs of their veſſels, that they were ſtrangers, and out of their courſe, took a piece of cloth, and made them a ſignal of entering the road he directed, to avoid the ſhoals and banks of ſand, they would otherwiſe have run upon; theſe poor people were ſo frightened at the ſight of this ſtranger, that they began to put to ſea again, yet the wind forced them back a ſecond time towards the ſhore; when they came near, the *Guivameſe* made the ſame ſignal as before; but ſeeing they did not mind it, but would unavoidably be loſt, he threw himſelf into the ſea, and ſwam to one of the little veſſels, on purpoſe to bring them ſafe in to ſhore; he was no ſooner got to them, but the women with their children on their backs, and all that were in that veſſel, threw themſelves overboard, and ſwam to the other; he ſeeing himſelf alone in the veſſel, reſolved to follow them, and getting aboard the ſecond, ſhewed them how to avoid the ſhoals, and brought them ſafe to land; in the mean time they ſtood immoveable, and reſigned themſelves up

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up entirely to the conduct of this ſtranger, as ſo many priſoners: The inhabitants of *Guivam*, running to the ſhore, received them very kindly, and brought them wine, and other proviſions; they eat *Cocoa*'s very freely, which are the fruit of the palm-trees of this country; their pulp is ſomewhat like that of cheſnuts, only that it is more oily, and it ſupplies them with a ſort of ſweet water, very pleaſant to drink; they gave them rice boiled in water, which is eat here, and all over *Aſia*, as bread is in *Europe*; they looked on it with ſurpriſe, and taking up ſome grains of it, threw them on the ground, imagining them to be worms; upon bringing them large roots, called *Palavan*, they eat greedily of them; in the mean time they brought them two women, that had formerly been driven on ſhore on the coaſt of *Guivam*, and who underſtood a little the language of this country; one of the women found amongſt thoſe ſtrangers, one of her relations, who as ſoon as they knew each other, fell a weeping; the inhabitants of *Guivam* ſtrove with each other, who ſhould entertain thoſe ſtrangers at their houſes, and furniſh them with proviſions and cloaths, and other neceſſaries: Of 35 perſons that embarked, there remained but 30, five dying thro' want of proviſions, and other hardſhips in ſo long a voyage; and ſome time after their arrival, another died: They related that their country conſiſted of 32 iſlands, which cannot be far diſtant from the *Marianas*, as may be judged by the make, and ſmallneſs of their veſſels, and the form of their ſails, which are very like thoſe of the *Marianeſe*; it is likely that theſe iſlands may be 11 or 12 degrees of N. Lat. more ſoutherly than the *Marianas*, and under the ſame degree of longitude, as *Guivam*; for ſailing directly from eaſt to weſt, they came aſhore at this town; it is likewiſe probable, that it was one of theſe iſlands, that was diſcovered ſome years ago at a diſtance, when a ſhip belonging to the *Philippines*, leaving the common courſe, which is from eaſt to weſt under the third degree of longitude, and running farther to the ſouth eaſt, firſt perceived it; ſome called this iſland *Carolina* from *Charles* II. of *Spain*; and others the iſland of St. *Barnaby*, becauſe diſcovered on that Apoſtle's day; and it was again ſeen 1695 by another veſſel, that a ſtorm had driven out of its courſe, in going from hence to the *Marianas*: Theſe ſtrangers added, that of theſe 32 iſlands, three of them were uninhabited, unleſs with wild fowl, but all the reſt very well peopled; upon aſking them the number of inhabitants, they pointed to a heap of ſand, to ſhew that their numbers were very great; the names of theſe iſlands are *Pais*, *Lamululutup*, *Saraon*, *Taropie*, *Valayyay*, *Sa-*

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tavan, Cutac, Yfalcu, Piranlop, Ytai, Pic, Piga, Lamurrec, Puc, Falait, Caravaruvong, Ylatu, Lamuliur, Tavas, Saypen, Tacaulap, Rapiyang, Tavon, Mutacuſan, Piyla Olatan, Palu, Cucumyat, Piyalacunung; the three iſlands that have nothing on them but wild fowl, are *Piculat, Hulatan, Tagian*; *Lamurrec* is the moſt conſiderable of all theſe iſlands, where the king of the country keeps his court, and to him the governors of all the other iſlands are ſubject; among thoſe ſtrangers there was one of the governors, and his wife, who was the king's daughter; tho' they went half naked, yet their carriage, and a peculiar air of greatneſs, ſufficiently diſtinguiſhed them from the reſt; the husband had his body painted all over with certain lines, in ſuch a manner, that they formed ſeveral figures; the reſt of the men were alſo painted in like manner, more or leſs; the women and children were not painted at all; there were 19 men, and 10 women, of different ages; the make and colour of their faces were much like that of the *Philippineſe*; the men had no other cloaths than a ſort of ſaſh, wrapped ſeveral times about their bodies, and covering their reins and thighs; they wore on their ſhoulders above an ell and a half of coarſe linen cloth, like a cowl tied before, and hanging looſe behind; both men and women were dreſſed much alike, only that the women had a piece of cloth ſomewhat longer, that hung from their waſte down to their knees; their language is different from that of the *Philippineſe* and *Marianeſe*; their manner of pronouncing comes neareſt that of the *Arabs*, as ſome who underſtood that language obſerved; the woman that ſeemed the moſt conſiderable amongſt them, had ſeveral rings and necklaces of tortoiſe-ſhell, called here *Carey*, and others made of a ſubſtance, much reſembling ambergreaſe, but not tranſparent: The manner of their living at ſea, which was for 70 days together, continually driven by the wind, was thus; they caſt out a ſort of net, made of a great many little twigs of trees, tied together, with a large mouth for the fiſh to enter in at, and terminating in a point, to prevent their getting out again; the fiſh they took after this manner, was all the nouriſhment they had, and rain-water ſaved in cocoa-ſhells, which is the fruit of the palm-tree, and of the figure and ſize of a human ſcull: They have no cows in their iſlands, and at the ſight of them they ran away, as they did likewiſe at the barking of a dog; neither have they cats, ſtags, horſes, nor in general, any quadruped; nor any fowl, but ſea-fowl, excepting hens, which they breed up, but never eat their eggs; notwithſtanding this their want of every thing, they are very

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very chearful, and contented with their condition; their ſongs and dances are exact, and regular; when they ſing, it is all in concert, every one obſerving the ſame humour and geſtures, which makes it very agreeable; they were ſurpriſed at the government, politeneſs, and manners of the *Europeans*; they admired not only the ſolemnities, and ceremonies of the church in celebrating divine ſervice, but alſo the muſic, inſtruments, dances and arms of the *Spaniards*; gunpowder was what ſurpriſed them moſt; they wondered at the whiteneſs of the *Europeans*, in reſpect of whom they are perfectly tawny, as well as the inhabitants of this country: It did not then appear, that they had either any knowledge of a deity, or that they worſhipped idols; their life is perfectly ſavage, minding nothing but eating and drinking, in which they obſerve no ſet time; but eat and drink at any time or place, when hungry or dry, and when they can find any thing to ſatisfy nature; yet they eat but little at a time, and never enough to ſuffice for a whole day; they ſhew a great reſpect and deference for their king, and the governors of their towns, and obey them very punctually; their civility and reſpects conſiſt in taking hold of the hand or foot of the perſon they would honour, and gently rubbing his face; amongſt their utenſils, they had ſome ſaws, not made of iron, but of a large ſhell, called here *Taclobo*, which they rub and whet, upon a certain kind of ſtone; they were ſurpriſed to ſee the number of carpenters tools uſed in building a merchant ſhip at *Guivam*; they have no metals in their country; the Father *Miſſionary* made each of them a preſent of a large piece of iron, which they received with as much joy, as if it had been ſo much gold, and for fear it ſhould be ſtole from them, they laid it under their heads, when they went to ſleep; they have no other arms than lances, or darts, made of human bones, very well ſharpened and fixed on; they are naturally very peaceful; but if any quarrel happens among them, it is decided with ſome fiſty cuffs on the head, which yet very rarely happens; for when they would come to a cloſe fight, they ſeparate them, and they are ſoon reconciled again; they are not dull and heavy, but on the contrary, have a great deal of livelineſs and courage; they are not ſo luſty, as the inhabitants of the *Marianas*, yet they are well proportioned, and ſhaped much like thoſe of the *Philippines*; both the men and women let their hair grow long, and hang looſe on their ſhoulders: When they underſtood that they were to be conducted to the preſence of the Father *Miſſionary*, they painted their bodies all over with a yellow colour, which is looked

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looked upon by them, as a great ornament; the oldeſt of theſe ſtrangers was once before caſt on the coaſt of *Caragan*: They are very expert at diving, and they ſaid, that in fiſhing they took two large pearls in their ſhells, but threw them into the ſea again, not knowing their value.

The new *Philippines* (ſituated between the *Molucca*'s, the old *Philippines*, and the *Marianas*, which have been known near 200 years) are 87 in number, and form one of the fineſt *Archipelago*'s in the eaſt; being incloſed on the north and ſouth, between the line and the tropic of *Cancer*, on the eaſt and weſt between the *Mariana*'s and *Philippines*.

The natives of theſe iſlands never offer any violence to each other, murder and homicide are unknown to them, and they have a proverb amongſt them; *viz. That one man never kills another*; it is probable, theſe iſlands may abound in gold, amber, and drugs, being ſituated nearly under the ſame degree of longitude as the *Molucco*'s, from whence we have nutmegs and other valuable ſpices: Tho' theſe people ſeem barbarous, yet they have amongſt them a ſort of politeneſs, and regular government; every iſland obeys its chief, who himſelf is ſubject to the king of the country; this prince holds his court in the iſland of *Falu*, called likewiſe *Lamuirec*: Tho' theſe iſlands were never heard of in *Europe*, till within theſe five or ſix years; it is a long time ſince from the high mountains of *Samal*, thick ſmokes were diſcovered on that coaſt, which commonly happen in ſummer, when theſe iſlanders ſet fire to their woods and foreſts, to clear up the ground; theſe ſmokes the fiſhermen of *Mandanao*, and other iſlands, had alſo obſerved, when far out at ſea.

An Account of the new Iſland, *thrown up near* Santerini; *by* F. Bourguignon. Phil. Tranſ. N° 317. p. 200.

ON *Monday* the 23d of *May*, 1707, O. S. at ſun-riſing, we obſerved between the two *Burnt Iſlands*, commonly called the *Great* and *Little Cameny*, a floating rock as it were; which at firſt we took to be ſome veſſel ſhip-wrecked on that coaſt, and ſeemed, as if it would in a little time be daſhed to pieces againſt the *Leſſer Cameny*, that was hard by; on which account ſome mariners, put out immediately to ſea, in order to view it; ſoon after we were ſurpriſed to hear by them, that it was a ſhoal, which began to ſpring up from the bottom of the ſea, and was not yet plainly to be diſcerned; next day ſeveral perſons went out of curioſity to ſatisfy themſelves; ſome of them went aſhore on this new ſhoal, which was ſtill moving, and ſenſible increaſed under their

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their feet; they carried from thence several curiosities, and amongst others a kind of oysters very large, and of an exquisite taste, which they found sticking to the rock, and raised out of the water, as the shoal had increased in height; particularly F. *Bourguignon*, observed a sort of stone, that at first sight looked much like bisket, but in reality was no other than a very fine pumice-stone, surpassing all he ever saw in *France*, or any other parts of *Europe*: Two days before the springing up of this shoal; *viz.* on the 21st, between twelve and one o'clock at noon, there was an earthquake felt over all the island, which could not reasonably be ascribed to any other cause, than the rising up of this mass of rock; from its first appearance to the 13th or 14th of *June*, it continually increased very sensibly, as well in bigness as in height, without any noise or disturbance; this shoal was very pleasant to look on, being of a white colour and round figure; the soil that composed it was light, with a small mixture of clay; this new island, according to the report of some learned and skilful persons, that were upon it in the beginning of *June*, was ½ a mile in circumference, and from 20 to 25 foot high; for five or six days it did not increase so sensibly as before; insomuch, that most people were persuaded, it had entirely ceased; and so were free from farther apprehensions; yet afterwards, the sea already much agitated by the raising up of this mass of earth, appeared more troubled every day than other, not so much by reason of this shoal being removed, and still floating, as on account of the mixture of a vast quantity of different matters, continually thrown up night and day from the bottom of the sea; so that a person might easily distinguish several sorts of minerals, by the diversity of the colour they produced on the surface of the water; but sulphur was the greatest quantity, insomuch that the sea about *Santerini*, was tinged with it, for near 20 miles distance; the excessive rolling of the waves about the new shoal was greater than ever; and a more than ordinary heat was sensible to any one, that approached too near; which undoubtedly, was the cause of such quantities of fish being found dead on the shore; every body felt a horrible stench, that infected the neighbouring air, and which at more than three miles distance, was often found of dangerous consequence; the boiling of the water, instead of decreasing, grew every day considerably greater; this struck every body with fresh apprehensions, which were farther increased, when on *Friday July* the 16th, at sun-set, they perceived between this new island and the lesser *Cameny*, a chain of black rocks, as it were, that rose up from a prodigious depth of the sea, to the number of 17

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or 183 not very distinct from each other, but seemed, as if they would shortly unite together, and join themselves to this new island, as they actually did some few days after; next day being *Saturday*, they were seen plainer; and those, whose tops could only be seen the night before, now appeared exceeding large; on *Sunday* smoke was first perceived to break forth, much resembling in thickness and colour, that of a burning furnace, and at the same time was heard certain murmurings under ground, which seemed to proceed from the center of this new island, as yet too deep in the sea, to be plainly distinguished; the rocks abovementioned united together, and seemed already to form another island distinct from the former; the smoke appeared more plentiful, and the fire at last began to break forth about the 19th of *July*; it was small at first, and of a dull colour; afterwards it increased by degrees, as the island increased and broke out more and more, and in different places; it was a no less frightful and surprising, than curious sight, to see every night on the top of this mount, that nature had lately formed, a vast number of burning furnaces, as it were all of a bright flame, in order and position not unlike those illuminations of the *Minarets*, which the *Turks* usually make at certain times every year. One night at the latter end of *July*, about an hour after sun-set, there appeared of a sudden, in the middle region of the sky, a fiery lance, seeming to come from east to west; but it disappearing again too soon, its dimensions could not be exactly observed; in the mean time the *Burnt Island* increased prodigiously, and extended itself, chiefly on the south and north sides; the sea also seemed much more disturbed, and was loaded with sulphur and vitriol; the boiling of the water was more fierce and violent, the smoke became thicker and in greater abundance, and the fire larger and more frightful; but above all, a stench that infected the whole country grew so insupportable, that persons of the strongest constitutions could hardly breathe in it; others that were weaker fell into frequent faintings, and almost every body was seized with vomiting; it was sometimes more in one place than in another, and more or less tolerable as the wind sat; this stench was very prejudicial, spoiling most of the vines; and a great smoke, that rose out of the midst of this new island, joining itself to a thick fog, that commonly hangs over *Santerini*, when the wind is at south, burnt and destroyed in the beginning of *August*, in less than three hours time, all the fruit that was ripe, and ready to be gathered in; especially, in such vineyards, as lay most exposed to the south; in 13 or 14 days time, there was a consi-

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conſiderable alteration in theſe two new iſlands; the white iſland, that did not ſeem to increaſe any more, was now grown conſiderably higher, and the black iſland was become much longer; both of them tho' different in colour were now united together, and formed but one iſland, as they remain at this time; the fire and ſmoke had made new vent-holes, and the noiſe under-ground was more frequent and audible; and from the midſt of the iſland peals were heard as of ſo many large cannon diſcharged, and at the ſame inſtant, a large quantity of burning ſtones was ſeen thrown into the air; theſe furious diſcharges, made the doors and windows, and ſometimes the beſt built houſes ſhake; and more than once F. *Bourguignon* ſaw ſtones all on fire, darted into the air out of ſight, and afterwards fall like a bomb, and be quenched in the ſea, at more than five miles diſtance: When theſe diſcharges happened, which were as loud as thoſe of a cannon, commonly a great flaſh of fire like lightning immediately enſued; and after that there ſprung up very ſwiftly, a black and diſmal ſmoke, mixed with aſhes, and ſo prodigiouſly thick, that when ſpread in the air, it formed a thick cloud of ſeveral colours; which by degrees, diſſolving into a fine duſt, fell like rain on all the neighbouring country, and more particularly *Santerini*, where it was ſo plentiful, that the ground was often covered therewith; the noiſe grew ſtronger and was louder, than if ſix or ſeven cannon had been diſcharged at once; the fire made itſelf every day more vent-holes, and became more dreadful; every night nature repreſented as great a variety of ſcenes, as the fire broke forth in different forms; ſometimes burning aſhes ſpread themſelves in the air, like a plume of feathers, which falling again upon the ſhoal, made it appear all of a light fire; at other times one would take it to be the actual diſcharging of ſo many mortar-pieces, which ſhot entire rocks like ſo many bombs, capable of deſtroying the largeſt ſhips; tho' for the moſt part, theſe ſtones were of a middle ſize, yet in ſuch quantities, that he often ſaw this little iſland all covered with them, and pleaſantly illuminated therewith: Theſe dreadful diſcharges were leſs frequent at the latter end of *Auguſt*, but increaſed in *September*, and happened daily in *October*, and afterwards became almoſt inceſſant; it is true, the noiſe was not ſo loud, nor the ſtones caſt up ſo large, nor in ſuch quantities; the boiling and agitation of the water was much abated; the ſea began to recover its former colour; the ſtench that was before inſupportable, was very little for ſix weeks; yet the ſmoke grew every day thicker, blacker, and in greater abundance; the fire was greater than ever, and ſeemed ſometimes

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to ſtrike the very ſky; the ſubterraneous noiſe was become continual, and ſo violent, that it could not be diſtinguiſhed from thunder: In a word, this new iſland grew every day more curious, more dreadful, and leſs acceſſible, and was ſo far from ceaſing to increaſe, at the approach of winter, that it was ſeen continually increaſing on the ſouth-weſt ſide, where nature ſeemed as if ſhe laboured to make a large port for ſhips; and on the 20th of *November* it appeared to be three miles at leaſt in circumference, and 40 foot high.

An Account of a Colliery *that took fire, and was blown up near* Newcaſtle; *by Dr.* Arthur Charlett. Phil. Tranſ. N° 318. p. 215.

ON *Wedneſday* the 18th of *Auguſt* 1708, at *Fatfield*, in the pariſh of *Cheſter le Street*, about three o'clock in the morning, by the ſudden eruption of a violent fire, which diſcharged itſelf at the mouths of three pits, with as great a noiſe, as the firing of cannon, or the loudeſt claps of thunder, threeſcore and nine perſons were deſtroyed in an inſtant; three of them, *viz.* two men and a woman were blown quite up from the bottom of the ſhaft, 57 fathom deep, into the air, at a conſiderable diſtance from the mouth of the pit; one of the men had his head almoſt off, and the woman had her bowels hanging about her heels; the engine, by which the coals were drawn up, and which was of a conſiderable weight, was removed, and caſt aſide by the force of the blaſt; and what was more ſurpriſing, the fiſh which were in a rivulet, that runs 20 yards under the level, and at as great a diſtance from the mouth of one of the pits, were taken up dead in great numbers, floating on the water; now whether this happened by the violent concuſſion of the air, or whether they were choaked with the ſulphur, that plentifully diſperſed itſelf abroad, he leaves others to determine; only he obſerved, that for ſeveral days a very ſtrong, and noiſome ſtench continued to come out of the pits: To account for this fire, it is to be obſerved that *Stith* commonly ſo called by the pitmen, which ſeems to be a corruption of ſtench, or ſtink, is a want of air, or rather ſuch a foulneſs in the air, as both ſuffocates the workmen, and extinguiſhes the candles; ſulphur again differs in this, that as the former does not ſuffer the candles to burn this latter makes them burn too faſt; and the flame, either impelled by the air, or attracted by the ſulphur, extends itſelf upwards into a prodigious length, and like a match lighted for the diſcharge of a cannon, as ſpeedily ſets on fire that vapour equally deſtruc-

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deſtructive: Now to prevent both theſe inconveniencies, the viewer of the works takes the beſt care he can to preſerve a free communication of air thro' all the works, and as the air goes down one pit, it ſhould aſcend another; but it happened in this colliery, that there was a pit which ſtood in an eddy, where the air had not always a free paſſage, and which in hot, and ſultry weather was very much ſubject to ſulphur; and it being then the middle of *Auguſt*, and ſome danger apprehended from the cloſeneſs, and heat of the ſeaſon, the workmen were withdrawn from that pit, and turned into another; but an overman, ſome days after this change being induced, as was ſuppoſed by a freſh, cool, froſty breeze of wind, which blew that morning, and which always clears the works of ſulphur, had gone too near this pit, and met the ſulphur juſt as it was purging, and diſperſing itſelf; upon which it immediately took fire by his candle, and ſo he proved the occaſion of the loſs of himſelf, and ſo many men, and of the greateſt fire that ever was known in theſe parts.

An Experiment for continuing ſeveral Atmoſpheres *of condenſed* Air *in the ſpace of one, for a conſiderable time; by Mr.* Francis Hauksbee. Phil. Tranſ. N° 318. p. 217.

ON *March* the 20th Mr. *Hauksbee* injected with his ſyringe into a very thick flint glaſs bottle, between four and five atmoſpheres of air, as appeared by the included gage, and which continued in that ſtate, till about the 7th of *Auguſt* following; when looking on it (as he commonly did once in four or five days) he found that the air injected at the above-mentioned time, had made its eſcape, the weather for a week before, or ſo having been very hot; one day in particlar he obſerved the ſpirits in the thermometer had aſcended 120 degrees above the freezing point; and notwithſtanding the bottle was continually kept under water, yet the cement, that was made uſe of to faſten the braſs cap to it, became ſo ſoft, as to render it incapable of reſiſting the ſpring of the injected air; he obſerved that tho' all the air, which was capable of elaſticity was fled, yet the mercury in the gage remained about $\frac{3}{4}$ of an inch in height, above the ſurface of that, wherein its open extremity was immerſed; which was about $\frac{1}{6}$ leſs ſpace, than what the ſame air poſſeſſed before the injection, and remained ſo, notwithſtanding it was conſtantly expoſed to the open air; which plainly ſhews that the ſprings, or conſtituent parts of the air, do not in time totally reſtore themſelves, after ſtanding ſo long bent; and had not the heat come on, but the air continued in that ſtate, as at firſt injected, for a year or two, he did

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did not doubt, but its ſprings would have been rendered much more incapable of reſtitution; from hence it is eaſy to conclude, that if 9 or 10 atmoſpheres of air were condenſed into the ſpace of one, and remained in that ſtate for a year or two, when the veſſel that contained them, ſhould be expoſed to the open air, ſuch bodies as very thin glaſs-bubbles (ſuppoſing them not to be above five or ſix times ſpecifically heavier, than their like bulk of common air) would float on ſuch a medium; but this he is not ſure of; and he could not tell, but it might be a means to render air viſible.

An Experiment, ſhewing the production of Light *within a* Glaſs-globe, *whoſe internal ſurface is lined with* Sealing Wax, *upon an attrition of its outſide; by the Same.* Phil. Tranſ. N° 318. p. 219.

MR. *Hauksbee* took a glaſs-globe, about ſix inches diameter, into which putting a convenient quantity of broken ſealing-wax, he held it over a moderate fire, till it melted, then turning it about from one part to the other, it ſoon had a pretty thick lining of it (eſpecially ſome parts, for he could not make it all alike) on more than half its inſide; thus he placed it in a convenient poſition, till it was perfectly cold, when in the evening, after having fixed the braſs-work thereto, he cauſed it to be exhauſted of its air; then fixing it on the machine, to give it motion as uſual, he no ſooner held his hand on that part of it, which was lined with the wax, but the figure of the parts that touched it, was as viſible on the inner ſurface of the ſealing wax, as when the glaſs alone is uſed for that purpoſe; one could but juſt diſcern the light of a candle in the dark, thro' the ſealing wax, where it was ſpread thineſt on the glaſs; but ſome parts were ſo covered with it, that it was at leaſt $\frac{1}{8}$ of an inch thick, and even on thoſe parts the light and figure appeared to Mr. *Hauksbee* as vivid, and diſtinguiſhable as any where elſe; the light produced, was not at all diſcernible thro' the body of the wax, but only to be ſeen thro' the tranſparent part of the glaſs; and notwithſtanding, ſome parts of the ſealing wax did not adhere ſo cloſely to the glaſs, as others, yet the light appeared on thoſe parts, as well as on the other: Now whether the light on the ſealing wax was produced from the effluvia, cauſed by the attrition of the ſurrounding body of glaſs; or from its own diſpoſition ſo to do in ſuch a medium, Mr. *Hauksbee* could not determine; it being in all reſpects of the ſame colour and likeneſs with that of glaſs; only that upon the admiſſion of a ſmall quantity

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quantity of air into the receiver, the light entirely disappeared in that part lined with the wax, and not in the other parts; he farther observed, when all the air was admitted, that the hoop of threads being held over the glass, they would be attracted at a larger distance, by that part of it lined with the wax, than by the other parts, which Mr. *Hauksbee* supposed to proceed from the united force of both their effluviâ.

Upon a repetition of this experiment, he observed that the wax within the glass would attract bodies brought near its outside, and that even *in Vacuo* (which he could never discover of any other body, in such a medium, excepting the magnet) for holding the hoop of threads over it, while it was in that state, they would be directed, but not with that vigour, as when all the air was admitted; yet there was this sensible difference, that when the threads were held over that part of the glass free of wax, they would not be attracted; but upon bringing them within the reach of the effluvia of the wax, they would eagerly fly towards it: Hence it seems deducible, that the figure of the parts of glass, and sealing wax, are much alike; otherwise, Mr. *Hauksbee* could not conceive, how the effluvia of one could with such ease pass and penetrate the body of the other, and there act, as if it was one and the same with it.

An Account of some Experiments, in relation to the Weight of common Water *under different Circumstances; by the Same.* Phil. Trans. N° 318. p. 221.

FIRST Mr. *Hauksbee* took a glass of common water, and weighing nicely a glass bottle therein, whose bulk was equal to that of 575 grains of the same fluid, he then caused some of the same water to be boiled over the fire; and afterwards he included it *in Vacuo*, where it remained, till it became of the same temperature, as to coolness, with common water; thus he endeavoured as much as possible, to exhaust all the air out of the water, imagining that in that state it would become more dense, than when he first weighed the bottle therein; but contrary to his expectation, he found that the bottle had just the same weight in it, as before; which seems to confirm the impossibility of compressing water into a lesser space, than it naturally possesses; for if upon the removal of such a quantity of air out of the body of the water, the parts do not slide any closer together, how should a weight laid upon its surface, when its interstices seem to be replete with air, make any impression thereon? The body which was forced out of the water by the above-mentioned means,

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means, Mr. *Hauksbee* calls air, since he found it subject to the same laws with common air; but that the water, upon the absence of that air, should not unite more closely than before, seemed very surprising; for he could not conceive what matter must supply the vacuities, since the particles of water remain at the same distances, as if the air was not exhausted, otherwise the water must have necessarily become more dense; but to proceed, he caused some water to be heated blood-warm, and weighing the bottle therein, he found the bulk of water equal to that of the bottle, which was about three grains less, than when cold; which shews, that the constituent parts of the water are easily separated by heat, and the matter lodged in its interstices, capable of dilatation; then he took that water which he had cleared as near as possible of all its air, and gave it a degree of heat, not exceeding luke-warm; upon weighing the said bottle therein, he found that tho' the heat it received, was very inconsiderable, yet the bulk of the water in that state, equal to that of the bottle, was now diminished two grains; which plainly shews, that notwithstanding the water contained no air, that he could discover yet, there seems to be a matter latent therein capable of intumescence.

An Account of some surprising Effects of the Scurvy *at* Paris; *by M.* Poupart. Phil. Trans. N^o^ 318. p. 223.

IN 1699 M. *Poupart* going to the hospital of St. *Lewis* at *Paris*, where were a great many scorbutic patients, observed that this distemper had something in it of that terrible plague, with which the *Athenians* were formerly afflicted, *Lucret* lib. 6: It had the common symptoms, as pains in the thighs, calves of the legs, belly and stomach, and the patients were deprived of the motion, or use of their limbs, tho' they still retained their feeling; they were troubled with head-achs, convulsions, and uncommon itchings in the gums, and the blood which came from them was watery, salt, and corrosive, the stench, which proceeded from the mouth, was intolerable; they had hard blue spots on their legs and thighs, frequent hemorrhages, or bleedings at the nose and fundament, and also so great a weakness in their knees, that they could not go without reeling, or staggering: The particular symptoms were, that upon the motion of any of these patients, there was heard a small clattering of their bones, which particularly M. *N*—— *V*—— a physician of *Rochel*, mentions in his *Treatise of the Scurvy*, but could not assign the true reason of it: M. *Poupart* observed, upon opening all those bodies, in which

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which the aforesaid noise was heard, that the *Epiphyses* were entirely separated from the bones, which by rubbing against each other occasioned this clattering; several young persons were opened in whom when alive, a small low noise was also perceived, when they breathed; and in all these subjects, the cartilages of the *Sternum* were separated from the bony part of the ribs; and as the cartilages are of a softer substance than the *Epiphyses*, the noise, which their rubbing produced, was less than that of the bones, which rubbed against the *Epiphyses*; but after the cure, this noise was no longer heard; all those in whose breasts any matter, or serosity was found, had their ribs separated from their cartilages, and the bony part of the ribs, over against the *Sternum*, was carious for four inches in length, which shews, that the *Lympha* of these bodies was exceeding caustic; the greatest part of those opened had their bones black and carious; most of the patients went staggering, as is usual in scorbutic cases; the reason of which is, that the support of the joints is owing to the force and spring of the ligaments, which bind the bones close to each other; and as the ligaments of these patients were corroded by a sharp *Lympha*, and loosened, the bones were consequently separated from each other; all the young persons under 18, had in some measure the *Epiphyses* separated from the body of the bones, and by the least force they were separated entirely; the reason of which is, that young people have not yet their *Epiphyses* so strongly fastened to the bones; so that when never so little soaked in that corrosive *Lympha*, which is in the joints, they may be easily separated entirely; all the bones thus separated from their *Epiphyses*, were twice as big as in a natural state; because well soaked in a water, which had penetrated into their very substance, and made them swell; the bones of such as recovered, or were recovering remained swelled, without giving them any pain; they might become less in time, as happens to children, troubled with the rickets, whose bones gradually dry, as they grow up; all those who had a difficulty in breathing, or their breasts stuffed or stopped up, had therein a great deal of *Lympha*, or matter; and some patients were so oppressed as to die suddenly, tho' no *Serum* was found either in their breasts, or lungs; but the *Pericardium* entirely adhered to the lungs, as did the lungs to the *Pleura*, and diaphragm, and all the parts were blended together in such a manner, as to make up one confused mass, or lump: Now as the lungs were compressed amidst this mass, they were deprived of their motion, and the patient choaked for want of breath; the close adhesion and confusion of

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theſe parts with each other, was owing to their being ulcerated; common ſcorbutic patients have the glands of the meſentery much obſtructed, and ſwelled; thoſe in the preſent caſe had theirs partly corrupted, with impoſthumes in its ſubſtance: In the liver of a few, the matter or *Pus* was hardened and petrified, as it were; the ſpleen was three times bigger than uſual, and fell to pieces, as if it conſiſted of clotted blood; and ſometimes the kidneys, and breaſt were full of impoſthumes; there were ſome bodies of thoſe of 15, in which upon ſqueeſing the extremity of the ribs, that began to be ſeparated from the cartilages, which was the ſpongy part of the bone, there would iſſue a great deal of corrupted matter, ſo that afterwards there remained nothing of the rib, but two bony plates; ſome patients had no other ſymptoms of the ſcurvy, than ſome ſlight ulcerations in the gums; they afterwards had ſome ſmall red hard tumors on the hands, inſteps, and in ſome other parts of the body; after that, there appeared large impoſthumes on the groin, and under the arm-pits, accompanied with ſeveral blue ſpots over all the body, which were the certain fore-runners of death; the glands under the arm-pits were very big, and ſurrounded with corrupted matter, or *Pus*, as were alſo the muſcles of the arms and thighs, whoſe interſtices were all filled therewith: There were ſome, whoſe arms, legs, and thighs were of a reddiſh black, and burnt, as it were; which proceeded from that black, and coagulated blood, that was always found under the ſkin of thoſe perſons; their muſcles were alſo ſwelled, and very hard, which was owing to the blood, fixed in the body of the muſcles, wherewith they were ſometimes ſo replete that their legs remained bent, without being able to extend, or ſtretch them out; the blue, red, yellow, and black ſpots, obſerved in the bodies of ſuch, as have the common ſcurvy, are entirely owing to extravaſated blood under the ſkin; as long as the blood retains its red colour, the ſpot is red; if the blood become black, or coagulated, the ſpot is alſo black; when ſome bile is mixed therewith, the ſpot is yellowiſh black; in ſhort, as the blood happens to be mixed with humours of different colours, ſo the ſpots appear of different colours too: On the bodies of theſe patients certain ſmall tumours, which grew larger every day, were ſometimes obſerved; emollient unguents were applied to ſoften them, and on their breaking, they formed a ſcorbutic ulcer, which was owing to the blood, with which the tumour was filled; for as often as the plaiſter was removed, a great deal of coagulated blood was found under it; and continuing to dreſs it, and take away the blood, the tumour

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was entirely dried up, and the patient cured: ſome old perſons had ſuch large bleedings at the noſe and mouth, that they died of it, it being impoſſible to ſtop it, becauſe their *Lympha* was ſo ſharp, and corroſive, as to eat thro' the coats of the veins; and this kind of hemorrhage was ſo much the more difficult to ſtop, becauſe the blood of old people is more fluid and watery, than that of young perſons, who are ſeldom ſubject to this accident; both old men and women were troubled with ſuch violent fluxes, that the weakeſt died of them; but if they had ſtrength enough to withſtand them, they were ſoon cured: Some of theſe patients were ſo coſtive, that they could never go to ſtool, without taking ſome gliſters; and ſeveral of them had ſuch large ſwellings over all their bodies, hands, arms and feet, that they ſeemed to have been blown up; but many of them were cured by proper medicines, gliſters, and ſweetning juleps; a youth of 10 years of age, had his gums much ſwelled, and ulcerated; his teeth were eaten to the very roots, and his breath intolerably ſtinking; the ſurgeon was obliged to pull out all his teeth, for the better dreſſing his mouth, tho' they would have dropped out of themſelves; his gums were healed, but a tumor aroſe on the ſide of his tongue, as big as a walnut, in whoſe middle was a blueiſh hole, that degenerated into an ulcer, and which eat up half the tumour, the other half remaining whole and entire; ſome little time after, there appeared another tumour on the cheek, which was very hard; it was blue in the middle, and turned alſo to an ulcer, as the firſt; this youth died ſuddenly, and when leaſt expected; all the inward parts of his body were mortified: All thoſe who died ſuddenly, without having any viſible cauſe of their death, had the auricles of their heart, as big as one's fiſt, and replete with coagulated blood, which ſtopping the circulation, cauſed inevitable death; ſeveral patients had a ſmall white ulcer, on their cheeks, which was hard all round; unleſs care was taken to ſtop it directly, and take it off with the ſpirit of vitriol, it would preſently grow livid, or blue, black and ſtinking, and eat up part of the cheek, ſo that one might ſee the teeth thro' it: Several from the age of 18 to 30 were ſeen, without any pain, to drop down ſtupid and motionleſs, with their mouths open, their eyes ſunk in, their looks frightful, and appearing rather like ſtatues than men; all theſe had no apparent ſickneſs, only the gums were ulcerated; their ſkin was ſmooth and fair, without any ſpots or hardneſs; yet their muſcles were found mortified, and all wet with a black corrupted blood, and in handling they fell to pieces: One patient had a carbuncle

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on his inſtep, his lips and noſtrils were chopped, and a ſtinking water trickled down from the latter; he lingered out a long time and then died: A young man who to all outward appearance ſeemed not to be very ill, died ſuddenly; his *Pericardium* was ſo eaten up, that there remained, but a little of it, and his heart was very deeply ulcerated all round: Scorbutic patients are commonly better in ſummer, than in winter, which may be owing to their great perſpiration; but on the contrary, theſe were indifferently well from the month of *April* to the beginning of *June*, the ſpots, hardneſs, and other ſymptoms of the ſcurvy then diſappearing; but upon the coming on of the great heats, all thoſe ſymptoms returned; and ſuch as were ſo well, as to be ready to quit the hoſpital, relapſed again; their legs and thighs grew all black, and ſeveral of them died; this diſorder might ariſe from a too large quantity of corroſive *Lympha*, as could not be carried off by perſpiration, ſo that by ſtagnating in their bodies, it grew hot, fermented, ſoured and putrified; from thence aroſe thoſe corroſions, ulcers, large impoſthumes, mortifications, *&c.* all theſe patients eat very heartily to the laſt, which was owing to a ſharp humour, wherewith their ſtomachs always abounded, and which created in them a kind of *Fames canina*: Nothing is ſo apt to corrupt the blood, as long abſtinence; the uſe of bad food is ſtill worſe; cold ſtops the circulation, and makes the blood continue too long in the parts, where it ſours and ſoon corrupts; ſadneſs and grief (which theſe people were ſubject to) is worſe than all the reſt; and what all theſe may effect, when concurring in one perſon, we may eaſily judge; they produced *Lympha*'s of different colours, with which the belly, breaſt, and ſeveral other parts of their bodies were filled, and ſo cauſtic, that putting the hands into the dead bodies, the ſkin would come off, and the face become ulcerated; ſo that ſuch as touched them were obliged to waſh their faces with freſh water to take off the heat and ulceration: But what was very ſurpriſing in this extraordinary diſtemper was, that the brains of theſe people were always very ſound, and entire.

An Account of California; *by F.* Francis Maria Picolo. Phil. Tranſ. N° 318. p. 252.

California is pretty well placed in our common maps; the heats in the ſummer are very great along the ſea-coaſts, and it ſeldom rains; but the air of the inland countries is more temperate, and the heats not ſo exceſſive; it is proportionably the ſame in winter; in the rainy ſeaſon there are floods; but when that

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that is over, inſtead of rain, there falls ſuch plenty of dew every morning, that one would think it had rained, which renders the earth very fruitful; in *April*, *May* and *June*, there falls with the dew a ſort of manna, which congeals and hardens upon the leaves of reeds, from whence they gather it; it is as ſweet as ſugar, tho' not altogether ſo white: The climate is healthful; and *California* abounds in large plains, pleaſant valleys, excellent paſtures at all ſeaſons, for large and ſmall cattle; fine ſprings of running water, brooks, and rivers with their banks covered with willows, reeds and wild vines; they have plenty of fiſh in their rivers, eſpecially cray-fiſh, which they keep in a kind of reſervoirs, (till they have occaſion for them) that are very large and beautiful; there is alſo plenty of *Xicames*, of a better taſte than thoſe of *Mexico*; on the mountains there are *Meſcales*, all the year round, a fruit peculiar to this country; and in moſt ſeaſons large piſtachio's of ſeveral ſorts, and figs of different colours; the trees are very beautiful, and amongſt others, that which the *Chinos*, who are natives of the country call *Palo Santo*, bears a great deal of fruit, from which they extract excellent frankincenſe. There are 14 ſorts of grain that the natives feed on; they uſe the roots of trees and plants, and amongſt others, thoſe of the *Tynca*, to make bread of; they have excellent ſkirrets, and a ſort of red ſtraw-berries, of which they eat plentifully; they have alſo citrons, and water-melons, of an extraordinary ſize; the ſoil is ſo good, that moſt of the plants bear fruit three times a year; ſo that with ſome labour in cultivating it, and ſkill in managing the water, they render the country exceeding fertile; nor is there any ſort of fruit or grain, but what they gather in great abundance; beſides ſeveral ſorts of animals, known in *Europe*, and which are here in plenty, and good to eat, as ſtags, hares, coneys and the like; they have two ſorts of deer, unknown amongſt us, they ſomewhat reſemble our ſheep in make; the firſt ſort is as large as a calf of one or two years old; its head is much like that of a ſtag; and its horns, which are very large, like thoſe of a ram; its tail and hair are ſpeckled, and ſhorter than a ſtag's; but its hoof is large, round, and cleft like an ox's; their fleſh is very tender and delicious; the other ſort of deer, ſome of which are white, and others black, differ leſs from our ſheep; they are larger, and have a great deal more wool, which is very good, and eaſy to be ſpun, and wrought; beſides theſe animals, they have lions, wild-cats, and ſeveral others of the like kind as in *New Spain*: As for fowls, they have in *California*, all the kinds of them that are in *Mexico* and *New Spain*, as pigeons, turtle

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turtle doves, larks, partridges of an exquiſite taſte, and in great numbers, geeſe, ducks, and ſeveral other ſorts, both river and ſea-fowl: The ſea affords great plenty of very good fiſh; they catch pilches, anchovies, and tunnys, which laſt they catch on the ſhore with their hands; whales are often ſeen, and all ſorts of tortoiſes; the ſhore is filled with heaps of ſhells, larger than thoſe of mother of pearl; their ſalt is not from the ſea, but from pits; it is as bright as cryſtal, and ſo hard, that they are often forced to break it with hammers; it is a very good commodity in *New Spain*, where ſalt is ſcarce; *California* has been known near theſe two centuries, and its coaſts are famous for the pearl-fiſhery: F. *Picolo* does not doubt, but that there are mines to be found in ſeveral places, if they were ſought for; ſince the country is under the ſame degree, with the provinces of *Cinalao* and *Sonora*, where there are very rich ones: Yet the *Californians* amidſt all this plenty and riches of their country, content themſelves with the bare neceſſaries of life; the inland parts of the country are very populous, eſpecially towards the north; and tho' there is ſcarce a town, but what has 20, 30, 40, or 50 families in it, yet they have no houſes, but defend themſelves from the heat of the ſun in the day-time, under the ſhades of trees, and make a ſort of roof, of their leaves and branches, againſt the inclemency of the night; in winter they ſhut themſelves up in caves in the earth; and live there together little better than ſo many beaſts; the men go naked; they wear about their heads a fine linen fillet, or ſort of net-work; and about their necks, and ſometimes about their arms, for ornament, mother of pearl in divers figures, very finely wrought, and prettily intermixed with little round fruits, ſomewhat reſembling the beads of a chaplet; they have no other arms than bows and arrows, and a ſort of javelin, which they always carry in their hand, either to kill their game, or defend themſelves from their enemies; for their towns often make war on each other: The women wear from their waſte down to their knees, a kind of apron made of reeds, very neatly wrought and matted together; they cover their ſhoulders with the ſkins of beaſts, and like the men, wear about their heads a curious kind of net-work; they have likewiſe necklaces of mother of pearl, mixed with the ſtones of ſome ſort of fruit, and with ſea-ſhells, hanging down to their waſte, and in like manner, bracelets of the ſame: The common imployment of both men and women is ſpinning; they make their thread of long plants, which ſerve them inſtead of hemp or flax; or elſe of a cotton-like ſubſtance found in the ſhell of ſome ſorts of fruit; they make

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make the ornaments above-mentioned, of the finer ſort of thread, and fiſhing-nets and ſacks, or bags for ſeveral uſes, of the coarſer ſort of thread; moreover, the men employ themſelves in making diſhes and other kitchen utenſils, of various ſhapes and ſizes, of certain plants, whoſe fibres are very cloſe and thick ſet; in working which they are very well ſkilled; the ſmaller pieces ſerve for drinking cups; the larger for plates and diſhes, and ſometimes for umbrello's for the women; and the largeſt of all for baſkets to gather fruit in, and ſometimes for pans and baſons to dreſs their meat in; but they take care to keep them continually moving, while over the fire; for ſhould the flame catch them, they are ſoon burnt.

The *Californians* have a great deal of vivacity, and are naturally addicted to raillery: They have no form of government, religion, or regular worſhip amongſt them; they adore the moon, and cut their hair in her decreaſe, in honour of their deity, which they give to their prieſts, who employ it to ſeveral ſuperſtitious uſes: Every family make laws at pleaſure, which is plainly the reaſon, that they are ſo often at war with each other.

The Circulation *of the* Blood *in* Fiſhes; *by* M. Leewenhoeck. Phil. Tranſ. N° 319. p. 250.

M. *Leewenhoeck* viewed the hearts of ſeveral fiſhes, particularly that of the large ſilver-eel, whoſe motion laſted near four hours after it was extracted out of the body of the fiſh, and the rather becauſe that motion was ſo regular; for when the blood is protruded out of the heart, it is conveyed with the ſame velocity, into the great arteries, which in that caſe would be over-charged with the great quantity of blood; but the blood thus coming from the heart, is forced into a ſmall white veſſel, almoſt of the ſhape of a pear, and which one would take for a kind of bladder, one orifice was united to the great artery, and the other to the heart; in the latter orifice is a valve, whoſe uſe is to hinder the blood, protruded from the heart into the aforeſaid veſſel, that reſembles a pear, from returning again into it; upon cutting it acroſs, he obſerved that its inſide was furniſhed with a great number of ſmall particles, which in a great meaſure filled its cavity; and the deſign of theſe he ſuppoſed to be, that when the blood is protruded into the veſſel, by dilating and contracting itſelf, it might preſently force the ſame into the great artery; when the blood at each protruſion came from the heart into this veſſel, it was much diſtended, and then again immediately

diately contracted, that it might in this manner regularly and without intermiſſion, protrude the blood into the artery; for if this veſſel were not united to the heart, the blood could not be conveniently conveyed into the arteries, becauſe the arteries could not dilate themſelves to ſuch a pitch; and then M. *Leewenhoeck* ſuppoſes, that at every protruſion of the blood from the heart, there would be a ſtop for ſome time put to its flowing into the arteries; whereas in this caſe, the blood is almoſt always running with an eaſy and conſtant courſe; tho' at every protruſion it muſt be in ſome meaſure quickened, yet he ſuppoſes ſo inſenſibly, as that no body can obſerve or feel it: M. *Leewenhoeck* communicated in a former *Tranſaction* ſome diſcoveries relating to the circulation of the blood in eels; *viz.* that the blood, coming out of a great many ſmall veſſels in the tail of an eel, is collected into one larger blood-veſſel, where the fiſh-bones begin, and where the blood runs thro' a valve; for he obſerved, that the blood-veſſel was not only moved in that part, where the valve is, but likewiſe in the parts about it, for four or five hairs breadth; from whence it appeared, that at every protruſion of the blood into the heart thro' the valve, the blood ſtood ſtill about an inſtant of time, and then falling thro' the valve, ran with great velocity, and was thickeſt juſt at its protruſion out of the valve, but ran thinner and ſlenderer like the figure of a pear; and the vein that received this protruded blood, was not entirely filled therewith, but ſeemed to be empty as it were, for a ſmall ſpace, and its parts contracted, which could be perceived for a little time; and farther obſerving it, he ſaw the blood run ſlowly and leiſurely along the ſame veſſel.

From this obſervation M. *Leewenhoeck* imagined, that the ſame thing happened in a human heart; *viz.* that there is a gentle, and ſlow protruſion of the blood out of the heart into that veſſel, called the artery; and conſequently that there is no ſuch motion there, as what is called a pulſe, and which is felt in the extreme parts of the body; but that which is denominated a pulſe is only cauſed by the protruſion of the blood, thro' the valves that are in the veins; for he never obſerved any violent or ſwift protruſion of the blood into the arteries, as often as he had viewed its circulation; and tho' the blood, by the contraction of the heart, be ſuddenly and haſtily protruded out of it, yet it is ſlowly conveyed into the artery; whereas, on the contrary, it runs into the heart from the veins, with a violent and ſwift courſe; from whence it happens, as he ſuppoſes, that the remaining part of the blood in the veins being unable to follow with

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ſo ſwift a motion, is violently, and *per ſaltum* drawn or forced thro' the valves, and that it is this ſort of motion we take for pulſes in the arteries.

In order to ſatisfy himſelf in the above-mentioned obſervations, he viewed ſeveral times that ſort of motion in his arm, called the pulſe, at a time when his body was without motion, and warm; and after a diligent conſideration of it, he judged that that motion, which we perceive in the blood-veſſel, is not derived from the heart to the hand, but *è contrà*, from the hand to the arm, and ſo to the heart; from whence he concluded, that as in the tail of an eel there are no valves in the blood veſſels, as far as he could perceive, and that a great many ſmall blood-veſſels are united, as it were in that part where the fiſh bones begin, and form one large blood-veſſel, ſo there the firſt valve is; in the ſame manner in human bodies, a great many ſingle blood-veſſels running out of the hand, unite in the arm, where likewiſe the firſt valve is, thro' which the blood at each protruſion falls into the heart, and that is what we call the pulſe: M. *Leewenhoeck* obſerved ſeveral times in the exceeding ſmall veins, or capillary veſſels, a little riſing or ſwelling, occaſioned by a ſtronger motion of the blood than ordinary; which he firmly concludes, does only proceed from the ſudden motion or running of the blood thro' the valves; he alſo obſerved, that in ſudden frights, and otherwiſe, one feels ſuch motions at the extremities of the fingers, juſt as if they were likewiſe furniſhed with valves, thro' which the blood paſſes; but theſe ſorts of motion, he ſuppoſes, only depend on that quick motion of the blood, when it runs thro' the valve in the arm by the hand, and to which we give the name of pulſe: It is ſaid, that there are valves in all the veins of the body; but M. *Leewenhoeck* can hardly admit that aſſertion; for if there were ſuch in thoſe veins, which we can ſee with our naked eyes thro' the ſkin; for inſtance, either thoſe of the hand or arm, we ſhould certainly, he ſuppoſes, diſcover alſo the blood running thro' thoſe valves; and again, if there are valves in the above-mentioned veins of the arm or hand, we could not by preſſing thoſe veins with the finger, drive the blood back again, which notwithſtanding is often done: Moreover, if there were valves in the veins that lie in the ſkin, expoſed to our ſight, there would M. *Leewenhoeck* thinks, a great many inconveniencies ariſe therefrom; for if a blow, or thruſt were given upon that part where the valve lies, the blood could not retire back, by which means the valve, or even the vein itſelf might burſt; whereas, if there are no valves,

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the blood can eaſily retire upwards, or downwards in the veins; as in fact, we obſerve of thoſe veins, that run on both ſides in the tail-fins of an eel, which do not unite in one larger vein, where a valve is, at leaſt as far as he could trace thoſe veins with his eyes.

M. *Leewenhoeck* having in the month of *September* opened an eel, whoſe diameters or thickneſs was about an inch and a half, and having laid open the heart, he could not diſcover that part which receives the blood from the great vein, in order to convey it into the heart; but that he might the better diſcover it, he procured a ſmall glaſs tube, and putting it into the great vein at a little diſtance from the heart, he blew as much air into the ſaid vein, as might take up the ſpace of about half a pea; this air paſſed thro' the great vein into a little bladder (ſuch as he had never before obſerved thereabouts) that lay on the ſide of the heart; and no ſooner was the air got into that bladder, but it firſt contracted, and then dilated itſelf, as it were ſo regularly, and in ſuch a manner, that when the heart contracted itſelf (juſt as if it were going to protrude its blood) the aforeſaid little bladder with the air in it was dilated, and continued in ſuch a motion above five full hours together; tho' indeed, in the laſt hour it was ſo faint, that one could but juſt perceive it; and as for the heart, its motion was diſcontinued.

He moreover cauſed a pike-fiſh to be brought him about two foot long, and opening it immediately, whilſt it was in its full ſtrength of life, he obſerved not only the motion of the heart, and the regular motion of that part, which receives the blood, and conveys it into the heart, but likewiſe the motion of that other part, which receives the protruded blood from the heart, and conveys it gently into the arteries.

Plate IV. Fig. 1. A B C D ſhews the heart of a pike; D E F A repreſents that part, into which the blood is brought from the veins; and C D G, that other part which receives the blood from the heart, to convey it into the arteries: Now, when the heart receives the blood conveyed into it, it dilates itſelf into its utmoſt roundneſs, and then that veſſel repreſented by A D E F does at that very inſtant collapſe; and when the heart has diſcharged itſelf of its blood, the veſſel C D G is diſtended by the ſudden pouring in thereof, and no ſooner is it ſo dilated, but it contracts again, that it may force the blood into the arteries: In ſhort, when A D E F is contracted, and throws the blood into the heart, the heart is dilated; and when the heart is contracted by the diſcharge of the blood, C D G is dilated; and theſe three

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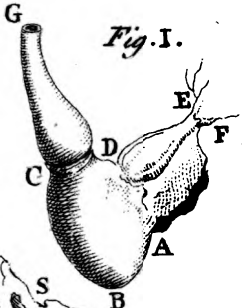


Fig. I.

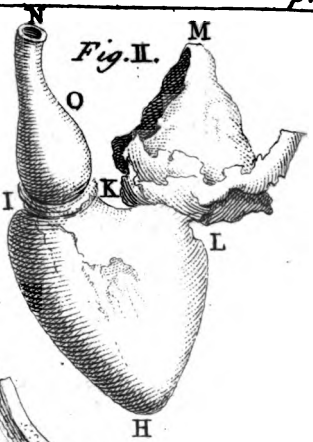


Fig. II.

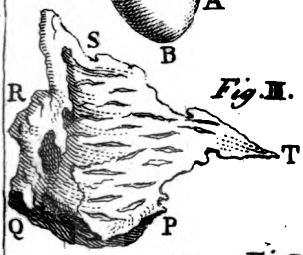
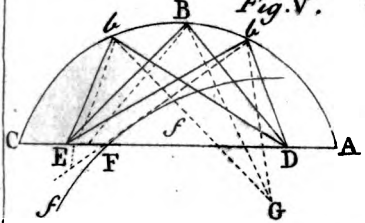


Fig. III.

Fig. IV.



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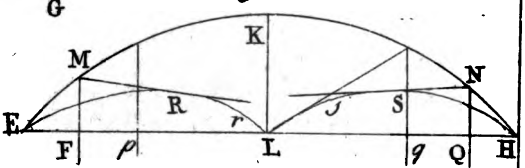

Fig. VI.

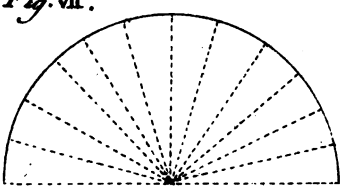

Fig. VII.

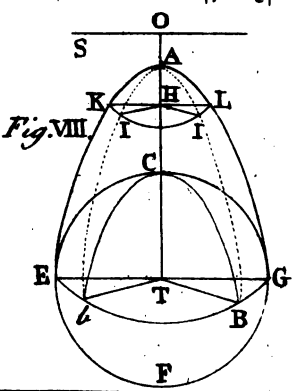

Fig. VIII.

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three ſeveral motions happen in ſo ſhort a time, and are performed ſo regularly, that it is quite ſurpriſing; and from hence we cannot but conclude, that ſuch a motion as this could not be brought about, unleſs the veſſel A D E F had a valve at A D, where it is joined to the heart, which valve is to prevent the blood, that is thrown into the heart, from returning again the ſame way; and ſo likewiſe, there muſt neceſſarily be another valve at C D to hinder the blood protruded from the heart, from flowing back again.

Fig. 2. H I K L repreſents the heart of a ſalmon, in which K L M ſhews that veſſel or inſtrument that was repreſented in the former figure by A D E F, as I N O repreſents that ſhewn in the ſaid figure by C D G; moreover, in Fig. 2. the inſtrument K L M is repreſented cut open, in order to diſcover with the naked eye, the ſinewy parts, and their branches; all which appeared as in Fig. 3. P Q R S T, wherein Q R is the part that was joined to the heart, and is the ſame that in Fig. 2. was repreſented by K L; in the ſaid Fig. 3. you may obſerve, how the ſinewy parts and their branches run from Q R to T; this inſtrument or veſſel is very ſoft in its parts, and did not ſeem to M. *Leewenhoeck* to be very ſtrong.

Fig. 4. V W X Y is that veſſel diſſected, which in Fig. 2. was repreſented by I O N; and this veſſel is exceeding thick and ſtrong, and like that repreſented by Fig. 3. being furniſhed within with ſtrong ſinewy parts; that when the parts happen to be diſtended by the blood poured into them, they may be able both in roundneſs and length to convey the blood into the arteries; theſe parts, by reaſon of their great numbers, could not be delineated in ſuch a manner as they ought to be.

From the whole M. *Leewenhoeck* is of opinion, that the heart protrudes the blood gently into the arteries, and that the blood which flows from the veins into the heart, cauſes that ſudden ſnatching or revulſion, called the pulſe; both as it cannot ſo immediately paſs thro' the valves, and as the veins in that place are a little narrower; by which means there is a kind of ſtop, or intermiſſion in the circulation of the blood; and this he takes to be the cauſe of that motion, called the pulſe.

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Several Experiments *on the ſeeming ſpontaneous Aſcent of* Water; *by Mr.* Francis Hauksbee. Phil. Tranſ. N° 319. p. 258.

Exp. I. MR. *Hauksbee* to ſatisfy himſelf, whether the figure of the veſſel might not contribute to the ſpontaneous aſcent of water, procured a couple of glaſs planes, about ſeven inches long, and one and a half broad; and tho' they ſeemed when clapped together, to touch each other in ſo many parts, yet when they came to be immerſed in a liquor, it would aſcend between them; but it was ſo thin, and colourleſs, as not to be eaſily diſcerned, tho' upon ſeparating the planes, they were found wet on all their parts; therefore to make it more obvious, he put a ſmall piece of thin paper on each corner, by which means, when laid on each other, they were ſeparated at ſuch a diſtance, as was equal to the thickneſs of the paper; in this manner he plunged one end into a liquor ſtrongly tinged, and immediately the water run gradually (but not with that velocity, as in a ſmall tube) ſometimes higher in one part, than in another; ſhooting itſelf very agreeably into branches divers ways, and thus it would continue, till it had arrived to its greateſt height; but that would be according to the diſtance the planes were placed aſunder; for if inſtead of one, two pieces of paper were laid on each corner of the planes, the water would not then aſcend ſo high between them, as when they were ſeparated by a ſingle piece of paper only; and then if the planes were any ways declined, the water would ſtill ſpread itſelf farther and farther, according to the degree of declination; and this upon ſeveral trials ſucceeded much the ſame.

Exp. II. Mr. *Hauksbee* having made the former experiment in the open air, tried what would be the effect *in Vacuo*; accordingly he fixed the two planes in ſuch a manner to a braſs wire (which paſſed thro' the cover of a receiver) that he could make them deſcend at pleaſure; in this manner he conveyed them with a diſh of tinged liquor, into the receiver, which being placed on the pump, he proceeded to exhauſt its contained air, which the gage in a little time diſcovered, to be pretty accurately done; then he plunged the planes (ſeparated by pieces of thin paper as before) into the water, where as in the open air, it aſcended between them, only with this difference, that there appeared more intervals, or ſpaces between the branches of the aſcending liquor in this, than in the former experiment; but when he came to admit

admit the air, these intervals vanished, and an entire body of the liquor succeeded; yet the exact figure of the upper parts thereof remained unaltered.

Exp. III. By the foregoing experiments Mr. *Hauksbee* found, that neither the figure of the vessel, nor the presence of the air, did any ways contribute to the production of the above-mentioned appearance; therefore, to try whether the quantity of matter would solve the phænomenon, he procured two tubes of an equal bore, as near as possible, but of very unequal substances, one of them being at least 10 times as thick as the other; yet when he came to plunge them into the above mentioned liquor, the ascent thereof seemed to be alike in both; therefore, Mr. *Hauksbee* in order to account for the said phænomenon pitches upon the magnet, as a body, that operates with equal vigour under the above-mentioned circumstances, and compares it with these experiments. 1. A magnet of any figure will attract iron; so by the first experiment, the figure of the vessel seems no ways to contribute to the ascent of the water. 2. The magnet is no ways impaired in its vigour of attraction, even in so thin a medium as a *Vacuum*: So by the second experiment, we find, that the presence of the air is no ways necessary to assist the ascent of the water in small tubes, or between the planes. 3. A magnet, as suppose one of a pound weight, that will take up, or suspend a piece of iron of the like weight, and no more, this magnet (supposing it to be of equal virtue in every part) when separated and broken into a number of small parts weighing about half a grain each, these dressed and armed according to art, will then be capable of suspending amongst them 50, nay perhaps, 100 times more the weight of iron, now that they are separated, than they could when all in one mass; from whence it appears, that the attractive quality of the stone seems to be increased in proportion, as its superficies is to its bulk of matter; so by the third experiment he found, that the greater quantity of matter in one vessel more than in the other, contributed nothing to the ascent of the water, which seemed entirely to depend on the largeness, or smallness of their cavities, as to the height it would rise to therein; and as their cavities are lessened, so the disproportion of their inward surfaces to their cavities is increased: And as the magnet, when broken into the above-mentioned number of small parts, will attract more, than when united in one mass, which is no more than separating, or working the above-mentioned thick body of glass into a number of small tubes, that is, multiplying the surfaces; so the water would rise in each of them singly, as it would, when all

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all in one body, its cavity being the ſame with the others; by which means, the quantity of water aſcending in them, is augmented from the ſame quantity of matter: To conclude, there ſeems to be ſuch a correſpondence between the qualities, or diſpoſitions of one and the other, that Mr. *Hauksbee* ſees no reaſon, why theſe effects ſhould not proceed from one and the ſame cauſe; for as the inner ſurfaces of the tubes are made ſmaller and ſmaller, ſo the power of their attraction (as is viſible by the high aſcent of the water in them) is greater and greater, and is moſt demonſtrable by the experiments of the planes; for their inner area being always the ſame, ſo that as they are placed nearer and nearer to each other, the cavity or ſpace between them becomes leſs and leſs, and conſequently, the diſproportions are increaſed, whereby the power of their attraction is augmented.

Exp. 4. Mr. *Hauksbee* took a glaſs-tube, about 32 inches long, and its bore near $\frac{1}{4}$ of an inch; this he filled at one end with aſhes finely ſifted, after firſt tying a piece of linen cloth at the other, to prevent their falling out; he ſtrongly rammed down each ſmall portion he put in, with a rammer, whoſe baſis was very little leſs than the bore of the tube; by which means, he crouded the aſhes as cloſe together, as poſſible; when the tube was full, he tied over that extremity a ſmall and limber bladder, after firſt expreſſing all the air out of its body, in order to receive that air, which he expected would be forced thro' the aſhes, upon the aſcent of the water; in this manner Mr. *Hauksbee* plunged the end of the tube, to which he had tied the linen, under the ſurface of water in a glaſs, and he found the water preſently begin to aſcend therein; it roſe a pretty pace at firſt; for in 16 minutes time it aſcended near an inch and three quarters; but as it roſe higher, its progreſs became ſlower; for at the end of 24 hours, the water had attained but to 16 inches, the bladder at the top being near half filled with that air, which had deſerted the aſhes, as the water aſcended in them; at the ſame time he found the upper part of the tube, to which the bladder was tied, cracked round about, and ſoon after it dropped off; however he had the deſired ſatisfaction, and continuing the experiment, he found at the end of 24 hours from the laſt obſervation, that the water had aſcended in the aſhes ſix inches higher, which was very diſcernible by the change of colour it gave then, diſtinct from thoſe that were dry: Again, at the like diſtance of time from the laſt obſervation, the water had riſen four inches and a half, and ſomething better: On the fourth day at the

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uſual time of obſervation, it aſcended three inches higher; and in 24 hours more, the water reached within half an inch of the top, having aſcended two inches in that time; about 10 hours after, it compleatly reached the extremity of the tube: Then in order to find what quantity of water the aſhes had abſorbed, he accurately weighed a glaſs of water, part of which he poured into the glaſs, wherein the tube had all along been kept, 'till it reached the mark the ſurface of the water ſtood at, when the tube was firſt plunged therein, and he found the quantity equal to the weight of 1792 grains, which is nearly the bulk of 7 cubical inches, the capacity of the whole tube, wherein the water aſcended, was only equal to about 13 cubical inches: Now this experiment ſeemed ſurpriſing enough to Mr. *Hauksbee*, from the following obſervations: 1. That the water not only aſcended in the aſhes, as it did between the above-mentioned planes, and the ſmall tubes, contrary to its natural gravitation, but with ſuch vigour, as to force and drive away pretty ſtrongly, the impriſoned air, contained in the interſtices of the rammed aſhes. 2. That the removal of this impriſoned air could not be performed, without a power ſurmounting its reſiſtance, which muſt be great, ſince upon endeavouring to force air thro' the body of the aſhes by the ſtrength of his breath, when the tube was not above half full, it proved unſucceſsful, not but that he believes, if the ſame force had been continued for ſome time, it would have found its way thro'. 3. That the water aſcends faſteſt at firſt, when there is a larger quantity of interſticial air to remove, than when the column of dry aſhes becomes ſhorter, by the higher aſcent of the water therein. 4. That notwithſtanding the tube was rammed as full as poſſible with aſhes; yet their interſtices were ſo many, as to receive or imbibe another body, equal in bulk to above half the contents of the whole. 5. That the water aſcended, not only in the aſhes adjoining to the inward ſurface of the tube, but equally in its whole body, as Mr. *Hauksbee* found upon examination. 6. That the air lodged in the interſtices of the aſhes, was protruded thro' them as the water aſcended, appeared by the intumeſcence of the bladder; and notwithſtanding the accident of the bladder's falling off, Mr. *Hauksbee* concludes, that its quantity muſt be equal to the like bulk of water, which ſupplied its place.

Mr. *Hauksbee* repeated the ſame experiment *in Vacuo*, in a tube much about the diameter of the other, but not above 10 inches in length; this tube being filled with aſhes, as before, was placed *in Vacuo*, where it remained ſome time, that the air

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contained in the aſhes, might eſcape; then plunging the lower extremity of the tube under ſome water, he found as he expected, that the water roſe faſter in the aſhes in that medium, than in common air; for in about four hour's time, it had reached its top; which plainly ſhews, that the preſence of the air is ſo far from being neceſſary in the production of this odd phænomenon, that it is a manifeſt impediment thereto.

Mr. *Hauksbee* procured a pair of marble planes, ground as true as poſſible; theſe joined together, dry, and without any thing between them, he plunged their edge about $\frac{1}{4}$ of an inch under the ſurface of the water, continuing in it for ſome minutes of time; then taking them out, he found, that he could not eaſily ſeparate them, without ſliding them one from off the other; which when he had done, it was eaſily diſcoverable how far the water had made its way between them, which upon divers trials, he found to be different; but at all times, after newly rubbing over the planes with wood aſhes, the water would aſcend higheſt: Now whether the ſmall duſt of the aſhes, adhering to the planes, might contribute any thing towards it, or whether they might clear them from any oily or viſcous matter, that might be communicated to them from handling them, Mr. *Hauksbee* could not then determine: Afterwards, he took a pair of round braſs planes, and ordered them as above; the ſucceſs was the ſame with the former.

Tho' two glaſs planes muſt touch each other in a great many parts, yet for all that, and notwithſtanding they are forcibly held together; ſpirits of wine, or oil of vitriol will inſinuate and aſcend, ſeemingly in an entire body, between all their contiguous parts.

Mr. *Hauksbee* afterwards obſerved, that in plunging the planes in ſpirits of wine, oil of turpentine and common oil, all theſe different fluids would riſe between them, as the tinged water, only with this difference, that the common oil roſe very ſluggiſhly, near an hour riſing to the ſame height, that the others would in leſs than $\frac{1}{2}$ a minute; they all roſe in an entire body from ſide to ſide of the planes, without thoſe interſtices, or ſpaces, which generally happen on the aſcent of water: He likewiſe took a couple of round glaſs planes, and laying them on each other, without paper, or any thing elſe to keep them aſunder, in this manner he plunged one edge juſt under the ſurface of the tinged liquor, and he found, that the water had almoſt inſtantly reached the extremities of the planes in all parts; by which we find, that the water not only aſcends directly upwards, but runs ſideways, obliquely, or in any direction.

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An Experiment on the different Denſities of common Water *from the greateſt Degree of Heat in our Climate, to the freezing Point, obſerved by a Thermometer; by the Same.* Phil. Tranſ. N° 319. p. 267.

MR. *Hauksbee* cauſed a quart of water to be heated near ſcalding hot, and then putting it into a convenient glaſs with his thermometer, the ſpirits ſoon roſe to the ball at top, where they remained till the water cooling, cauſed them to deſcend again; by this time both the ſpirits in the thermometer, and the water were become of an equal temperature; and when the ſpirits had deſcended to 130 degrees above the freezing point, Mr. *Hauksbee* began his obſervations, as follows, he weighed a ſmall bottle therein, and found the bulk of water equal thereto, in that ſtate, to be 574 grains; when the ſpirits had deſcended to 80 degrees above the freezing point, the bulk of water equal to the bottle, weighed then ½ of a grain, more than before; at 30 degrees above the freezing point, the quantity of water, equal to the bulk of the bottle, was again increaſed about ½ of a grain; at the freezing point, it ſtill weighed ſomething more; and in all it increaſed about two grains from 120 degrees above the freezing point, to that very point; which ſeemed conſiderable to Mr. *Hauksbee*, and which he thinks ought to be taken notice of by ſuch as judge of a mineral, or any other water by its weight, when they have not an opportunity of making the experiment at the fountain head; for there Mr. *Hauksbee* ſuppoſes, that the water is in all ſeaſons at the ſame degree of temperature: Now, according to this experiment, he finds that water is condenſible by cold, one twenty-eighth part of the whole, from the greateſt degree of heat in this climate; ſuppoſing then, that the water in the ſea ſhould undergo the ſame alterations, by the change of the different ſeaſons (as Mr. *Hauksbee* ſees no reaſon but it muſt very nearly) it would be eaſy to compute, that a ſhip drawing two fathoms, or 12 foot water, in ſuch weather, as is underſtood by the greateſt degree of heat, would draw about half an inch leſs from the greater denſity of the fluid, when reduced to the above-mentioned degree of cold, and conſequently would ſail better at that time: Since water then is capable of dilatation, and contraction by heat and cold, he ſees no reaſon, why the ſame may not be performed by force, notwithſtanding the ſeveral fruitleſs attempts hitherto made; for ſince the conſtituent parts of the fluid, are capable of being removed by heat, at greater diſtances from each other, and become more cloſely united by cold, he con-

concludes, that there must be some body contained therein of an elastic quality, and which therefore must be subject to the laws of that body; that is, be capable of compression by force, as well as become more dense by cold.

An Experiment on the Weight *of common* Water, *under different Circumstances; by the Same.* Phil. Trans. N° 319. p. 269.

FIRST, Mr. *Hauksbee* took a glass of common water, and having accurately weighed a glass bottle therein, whose bulk was equal to the bulk of 575 grains of the same fluid, he then caus'd some of the same water to be boiled over the fire, after which it was included *in Vacuo*, and there it remained, 'till it became of the same temperature, as to coldness, with common water; thus, he endeavoured as much as possible, to exhaust all the air out of the water, supposing, that in that state, it would have become more dense, than when he first weighed the bottle therein; but contrary to his expectation, he found that the bottle had just the same weight in it as before; which seems to confirm the impossibility of compressing water by force, into a lesser space than it naturally possesses; for, if upon the removal of such a quantity of air out of its body, the parts do not slide any closer together, how should a weight laid upon its surface, when its interstices seem to be replete with air, make any impression thereon? The body forced out of the water, by the above-mentioned means, Mr. *Hauksbee* calls air, since for any thing to the contrary, that he could discover, it is subject to all the same laws with it; but that the water, upon its absence should not unite more closely than before, seemed very surprising; for he could not conceive what matter must supply the vacuities, since the particles of water remain at the same distances, as if the air had not been exhausted, otherwise the water must necessarily become more dense: But to proceed, Mr. *Hauksbee* heated some water about blood-warm, and weighing his bottle therein, he found the bulk of water, equal to the bulk of the bottle was about three grains less than when cold; which shews, that the component parts of water are easily separated by heat, and the matter lodged in its interstices capable of dilatation; then he took that water he had purged of all its air, as near as possible, and gave it a degree of heat, not exceeding luke-warm; upon weighing the above-mentioned bottle therein, he found, that tho' the heat it had received, was very inconsiderable, yet the bulk of the water in that state, equal to that of the bottle, was now diminished two grains; which

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which plainly ſhews, that notwithſtanding the water contained no air, that he could diſcover, yet there ſeemed to be a matter latent therein, capable of intumeſcence.

Of the Nature and Properties of Sound; *by* S. Guido Grandio. Phil. Tranſ. N° 319. p. 270. *Tranſlated from the* Latin.

THE Archbiſhop of *Armagh*, *Phil. Tranſ.* N° 156. compares hearing with viſion; and as the latter is divided into direct, reflected, and refracted viſion, ſo in like manner, he divides the former into three parts, and conſiders not only direct and reflected (which have been long known) but alſo refracted ſounds; for, as he obſerved, that former ages had in a great meaſure perfected the doctrine of viſion, by optic, catoptric, and dioptric inventions, ſo likewiſe he did not doubt, but that the doctrine of ſounds, both with reſpect to the object, and medium, or organ, might be brought to perfection by acauſtic, catacauſtic and diacauſtic, or (he denominates them both ways) by phonic, cataphonic, and diaphonic inſtruments; and for that end he lays down ſome problems, which he not only exhibits without any demonſtration, but without any conſtruction: Yet the bare compariſon between optics and acauſtics, does not ſeem ſufficient to explain the latter, eſpecially as they differ in ſo many reſpects; for light is always propagated in right lines, ſound every way, and in curve lines; and notwithſtanding the interpoſition of any opaque body, becomes ſenſible; and even what the Archbiſhop lays down about the diffuſion of ſound, plainly ſhews the difference between that and the propagation of light; for he ſays that ſound glides with eaſe and great ſwiftneſs along walls, or very ſmooth arches, of an elliptic or cycloidal, rather than circular form, and is alſo more ſtrongly conveyed along the ſoft ſurface of water, which yields to thoſe ſonorous tremors, whereby the air is undulated: As to the ellipſis, this only is demonſtrated from catoptrics, that rays of light proceeding from one of its foci D, Plate V. Fig. 5. and falling on the elliptic curve ABC, ſhall after reflection be collected in the other focus E; but if the rays proceed from any other point, beſides the foci, they will no longer meet in one point, but be reflected in ſuch a manner, as to form, by their contacts the cauſtic curve F*f*; ſo that ſhould the eye be poſited above its convexity, would receive one or two reflected rays, and no more; but ſituated in the curve itſelf, ſome of the neareſt rays would fall upon it, and within its concavity it would have none at all reflected to it: As to the cycloid, the famous

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J. Bernoulli demonſtrates in *Act. Lipſiæ* A.D. 1697, that if a ray of light ſhould paſs thro' mediums, whoſe denſities in every point ſhould vary in the ſubduplicate ratio of their heights, it would be contiuually refracted in ſuch a manner, as to form a cycloid; but S. *Grandio* does not ſee, what the figure of a cycloid would contribute to the more eaſy propagation of light, either by reflection, or a direct propulſion thro' the ſame medium; for this curve has no foci at all, ſo that it cannot collect rays in any point, but the rays reflected therefrom form irregular curves; excepting, that when the rays P M and Q N, Fig. 6. parallel to the axis K L, fall on the cycloid E M K N H, then the cauſtic formed by the contact of the reflected rays M R, N S, would conſiſt of two cycloids E R L, H S L, generated by a circle of half the diameter, and exhibit the greateſt number of reflected rays about L, the termination of both, and the middle of the baſe of the reflecting cycloid; but in theſe as well as in other cauſtics reſulting from any poſition of the luminous point and the rays, the ſame obſervations hold, as were ſaid above, to agree to cauſtics formed by the ellipſis: As to the plane ſuperficies of water, it is manifeſt, that the rays of light paſs thro' it, either altogether refracted, or regularly reflected towards the oppoſite parts, in the ſame manner as from the ſuperficies of ſolid cryſtal; ſo far are they from moving with eaſe and expedition along the ſurface of water, as ſounds are ſaid to do; nay, it may be doubted, whether the beſt poliſhed mirrours would contribute ſo much to the reflection of ſound, as of light, ſeeing an echo is more frequently reflected from the rougheſt receſſes of caves, from deſart vallies, and ruinous edifices, rather than from the ſmootheſt and beſt plaiſtered walls.

Here S. *Grandio* attempts to explain, or rather gueſs at the meaning of the Archbiſhop's acauſtic or phonical ſphere, after firſt quoting his words:

I ſhall here add, ſays the Archbiſhop, *a ſemi-plane of an acauſtic or phonical ſphere,* Fig. 7. *as an attempt to explain the great principle in this ſcience, which is the progreſſion of ſounds; you are to conceive this rude ſemi-plane, as parellel to the horizon; for if it be perpendicular thereto, I ſuppoſe, the upper extremity will be no longer circular, but hyperbolical, and the lower part of it ſuited to a great circle of the earth; ſo that the whole phonical ſphere, if I may ſo call it, will be a ſolid hyperbola, ſtanding upon a concave ſpherical baſe.*

S. *Grandio* inſtead of this ſcheme, ſubſtitutes another, Fig. 8. let C G F E be the globe of the earth, and let a ſound be produced in

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in a point of its ſuperficies, as C; this will be propagated every way thro' the earth itſelf, as well as thro' the air; ſo that at the time it reaches, either really (tho' perhaps inſenſibly) or at leaſt (were it ſtronger) would reach upon its diffuſion thro' the air, a great circle of the earth, deſcribed from the pole C, *viz.* the periphery G B E, it would fill up a certain ſpace, according to the different facility of its paſſage, not quite ſpherical, but unequally extended, and circumſcribed by the perimeter of the hyperbola GL AKE, deſcribed about the axis CAQ perpendicular to the ſonorous body C, nay, defined by the ſuperficies of the hyperbolic conoid, generated by the rotation of the hyperbola ALG round its axis; therefore the whole phonical ſphere, thro' which ſound is propagated in a given time, will be the ſolid ſpace comprehended by the hyperbolic conoid G A E B, inſiſting on G B E a great circle of the earth, and terminated below by the concave hemiſpherical ſuperficies G C E B; which ſpace cut any where by a plane parallel to the horizon, will give the ſemi-circle L I K, ſuch as the Archbiſhop's figure repreſents, and which he calls a ſemi-plane; becauſe it exhibits only one half, the other half not appearing, as lying beyond the vertical hyperbola, which divides in two the phonical ſphere thro' its axis; but the Archbiſhop neither intimating the ſpecies of the hyperbola, nor the principles on which this doctrine is founded, S. *Grandio* propoſes to find, by the inverſe method of inveſtigation, the following particulars. 1. Thro' what lines ſonorous tremors muſt be diffuſed ſo as to be expanded in a given time into ſuch an hyperbola. 2. The variation of denſity to be ſuppoſed at different heights of the air, to give ſound a direction (ſuppoſing the common law of refraction of light) in thoſe lines; and 3. The law of refraction, which ſonorous tremors forming ſuch curves, do obſerve, ſuppoſing the variation of the denſity of the air, as moſt philoſophers and mathematicians allow, and as is conſonant to experiments, to be in the reciprocal ratio of the weight of the incumbent atmoſphere: For which let us conſider, that the ſonorous body C Pl.V. Fi. 1. communicates its tremors every way, in the directions C*n*, C*m*, C*h*; or at leaſt in the direction of the lines, wherein the impulſe was given the body upon its reſtitution, repelling the air, and protruding it by frequent oſcillations, whereby it undulates, and is ſollicited to a tremulous motion in the ſame direction; let therefore, theſe tremors be ſuppoſed in any the leaſt ſpace of time to reach the points *n m h*, and from thence after any given time to be propagated together, the firſt tremor to the point N, the ſecond to M, and the third to H; and again after any

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any other given time to be propagated together, the first to G, the second to L, and the third to A; now he denominates the lines C*n* N O G, C*m* M L, C*h* H A, in which each tremor is successively diffused the sonorous rays; and the lines *n m h*, N M H, G L A, which the above sonorous rays, and all the other intermediate synchronal rays reach in any given time at once, the sonorous waves; and indeed it is plain, that in a medium entirely uniform, when the cause ceases, that diverts the sonorous tremors from their direction into this or the other course, the sonorous rays always proceed in right lines, or move directly the shortest way from one point to another, and form waves entirely circular, and concentrical to the sonorous body; because, when they find no greater difficulty in their passage in one place, than in another, they will reach equal distances in any given time; and each ray will intersect its wave perpendicularly, and each wave be concentrical, and similar, as appears from the elements: But in a medium of a difform density, as our air, in which it varies according to its different altitude (for here we do not now consider the vicissitudes of heat, cold, moisture, and dryness, which cannot be reduced to any certain law) the ray C H A alone passing perpendicularly thro' all the *Lamellæ*, or superficies of air, concentrical to the earth, will be unrefracted, and proceed in a right line; whilst the other rays impinging obliquely on the same superficies, will be continually refracted in each point, and inflected into the curves C*m* M L, C*n* N G; and according to the various facility of their passage, be propagated in any given time to different distances; wherefore, the points A L G, or H M N, which the sound emitted in the direction of any ray shall reach in the same time, will be unequally distant from the sonorous body C; and therefore, the waves A L G, H M N, *h m n*, will by no means be concentric circles to the sonorous body, but curves of another kind, which yet must be similar to each other, and similarly posited; wherefore, if in the Archbishop's hypothesis, the extreme wave A L G, touching the outmost confines of the terraqueous globe, be an hyperbola, all the other intermediate waves H M N, *h m n*, must also be similar hyperbola's, and similarly posited; and tho' described from different vertexes A H *h*, yet from the same center to the same axis, and under similar figures of the *latus rectum & transversum*; for whatever reason proves, on account of the simultaneous appulse of sound to the points A L G, in the synchronal rays C H A, C M L, C N G, that A L G becomes a curve of such a kind, suppose an hyperbola; the very same reason will, on the same prin-

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principles evince, that also, on account of the simultaneous appulse of sound to the points H M N, along the synchronal rays C *h* H, C *m* M, C *n* N, the wave H M N will become a curve of the same kind; *viz.* in this case, a similar and similarly posited hyperbola, as is evident; and moreover it is plain, that the sonorous rays C H A, C M L, C N G should always intersect those similar waves A L G, H M N, *h m n*, perpendicularly, or at right angles, as is the case in circular waves; as *Huygens* demonstrates of the waves of light in p. 44. of the *French* edition of his treatise on light; therefore, the investigation of the path, along which the sonorous rays, according to the Archbishop's hypothesis, are propagated, is reduced to this purely geometrical problem; viz. *to find the nature of those curves that intersect perpendicularly any similar hyperbola's, and similarly described from the same center, and about the same axis.*

Let the similar hyperbola's A L G, H M N, *h m n*, Fig. 2. and other innumerable intermediate hyperbola's, be similarly posited, either above or below, having the same common center O, and described about the same axis O A H, whose conjugate is O S, thro' the point C; draw the curve C *m* M L, or C *n* N G, intersecting all the given hyperbola's perpendicularly; and thro' the given point C describe between the assymptotes O A, O S, the hyperbola C *m* M L of such a nature, that putting the ratio of the *Latus transversum* of the former hyperbola's A L H M, &c. to the *Latus rectum* of the same, equal to the ratio of t to r; and supposing the powers of the ordinates L Q be nominated from the exponent r to be reciprocally proportional to the powers of the *Abscissæ* O Q, from the center denominated from the exponent t; that is, putting O Q $= x$, and Q L $= y$; so that $y^r = \frac{1}{x^t}$; or drawing any other ordinate *m i*, M I, so that the ratio of the distances O Q, O I, from the center, be reciprocally as the multiplicate of the ratio of the applicates I M, Q L, as the fraction $\frac{r}{t}$ is multiple of unity; this I say resolves the question; for drawing the tangent L P of any hyperbola A L, in a point, where it is intersected by the curve C M L, as also S L R the tangent of the hyperbola C M L in the same point, it is plain from what S. *Grandio* has shewn in his demonstration of the theorems of *Huygens Cap.* 7. N° 9. that N Q will be to Q R, as the exponent of the power of the distances O Q, to the exponent of the power of the ordinates Q L, that is, as t is to r; but as t to r; *i. e.* as the *Latus transversum* is to the *Latus rectum*,

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tum, ſo (by the 37. *Lib. Conic*) is the rectangle O P Q to the ſquare Q L; therefore, as O Q to Q R, or aſſuming the common altitude Q P, as the rectangle O Q P to the rectangle P Q R; ſo the rectangle O Q P to the ſquare Q L, which will therefore be equal to the rectangle P Q R; wherefore, the angle P L R will be a right angle; whence, the curve C M L will meet the hyperbola A L G perpendicularly in the point L; and in the ſame manner, it may be demonſtrated perpendicular to other hyperbola's H M N, *h m n*, in the points M *m*, in which it interſects them, Q.E.D.

Hence we may conclude, 1. That if the hyperbola, determining the Archbiſhop's phonical ſphere, *viz.* A L G, and other ſimilar concentric hyperbola's H M N, *h m n*, be equilateral, then, becauſe of the equality of the *Latus rectum* & *tranſverſum* *r* and *r*, the hyperbola C M L will be the *Apollonian* hyperbola, and likewiſe equilateral; for its above-mentioned equation will be transformed into this; *viz.* $y = \frac{r}{x}$; where the ratio of the ordinates will be ſimply reciprocal of the ratio of the diſtances from the center; wherefore, both the ſonorous rays and ſonorous waves would, according to this hypotheſis, be hyperbola's of the ſame kind, only differently poſited; and Sir *Iſaac Newton* in his optics *lib.* 3. *Obſ.* 10. p. 287. ſhews that rays of light paſſing a-croſs the edges of two knives in a darkened room, are likewiſe inflected into hyperbolic fringes, as C M L; of which *Phænomenon* could a phyſical reaſon be aſſigned, the ſame might poſſibly convince that, according to the Archbiſhop's hypotheſis, the rays of ſound are likewiſe hyperbolical. 2. It is to be obſerved, that if many ſuch curves, or hyperbolic rays, as *m* M L, *n* N G, &c. be deſcribed, interſecting the hyperbolic waves A L G, H M N, &c. perpendicularly, they cannot meet exactly in one point C, tho' they may approach nearer and nearer towards C, and arrive to a diſtance leſs than any given diſtance; wherefore, theſe hyperbolic rays are to be ſuppoſed to proceed from a corpuſcle C of ſome extenſion, and not from ſome mathematical point, which is very proper; for ſound is produced from the colliſion of bodies, and not from the tremor of one ſingle mathematical point; nay, ſince all the waves, propagated from the ſonorous body, ſhould as we have ſhewn above, be ſimilar hyperbola's, it is proper to conceive the ſonorous body C as a very minute fibril, frequently vibrating, and whoſe ſmalleſt, and as it were, initial wave 2, 3, 4, is almoſt infinitely ſmall, and really hyperbolical, or rather the phyſical *Apex* of ſome hyperbola; ſo that

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that the oscillatory fibril of the sonorous body C, whilst struck upon, is by the force of percussion driven from its direct situation 2 C 4 into the concave position 2,5,4; and then again restored by the force of a very strong elasticity and its own tension, it swells into the convex hyperbola 2,3,4; and thus vibrating alternately it expands its tremors into hyperbolic waves, always similar to the initial waves 2,3,4 and 2,5,4 both upwards and downwards, and in a free medium; but should the fibril happen to be impeded by the interposition of the earth C E, whose center is T, it may propagate its hyperbolic waves only upwards, and describe the phonical sphere devised by the Archbishop, whose inferior part is interrupted, and defined by the terrestrial hemisphere; but should the doctrine of *F. Pardies*, in the 81st article of his statics, hold true; *viz.* that extended strings do by their own weight really assume an hyperbolic figure, such as 2,5,4, whose center is the same with that of the earth, it is plain, that this would confirm our author's hypothesis; for hence a reason might be assigned, why any fibril of the sonorous body C, whilst sollicited to harmonical vibrations, would expand itself into the hyperbola 2,5,4, having its center in the center of the earth T, and in like manner swell into another hyperbola 2,3,4 equal thereto, and from thence diffuse its tremor into other larger hyperbola's, all whose center would be O, equally distant from the sonorous body C, as this last itself is distant from the center of the earth; wherefore the distance C O, equal to the semi-diameter of the earth, would determine the boundaries, beyond which no sonorous wave could be propagated, and no sound be heard; and the line O S, as being the assymptote of any number of hyperbolic rays, wherein sound is conveyed, would constitute the limits of those happy regions, wherein we may philosophize securely and without interruption: But that none may contemn this speculation, because any fibril of a sonorous body, as being very short and greatly distended, should always seem to continue in the streight position 2 C 4, and never be inflected into the concave or convex hyperbola's 2,5,4, 2,3,4, it is further to be considered, that the greater the axes of hyperbola's are, the more they are enlarged, and the nearer they approach to a right line; therefore, on account of the vast distance of the centers T, or O, as the lines, which falling bodies describe, tho' tending towards the center T, are taken for parallel lines, and the arch of an horizontal circle confounded with its tangent; so in like manner these initial hyperbola's 2,5,4, 2,3,4 may be said almost to coincide with the right line 2 C 4; whence, the incurvation of

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the vibrating fibrils in a sonorous body is not sensible, nor does the species of the hyperbolic waves discover itself, till being dilated into a larger space GLALG they approach nearer their center: Yet still it is to be observed, that from these principles it would follow, that sound could not be diffused laterally, beyond the space comprehended by the extreme hyperbolic rays 2,9,8,g,4,6,7,g, to which the right-lines T2, T4 would be tangents, drawn from the center of the earth thro' the extremities of the vibrating fibre; and, indeed, the tremors of that fibre would not be propagated in any other direction, than in the lines T2, T3, T4, and other intermediate lines, comprehended by the angle 2 T 4, and corresponding to each particle of the same fibre; therefore, the space without the said hyperbola's 2,9,8 g, 4,7,6 g, would have no harmonical tremors, nor according to the Archbishop could the phonical sphere be extended to the entire hemisphere of the earth; therefore, no one single fibril of a sonorous body can ever really vibrate, but it must also affect, and in like manner solicite to harmonical tremors other fibres, with which it is connected, and between which it lies distended, which again must affect others; just as the tense string of a musical instrument, does evidently communicate its tremors or vibrations to the wood, to which it is fastened; therefore, upon striking the fibre of a sonorous body, the harmonic oscillations are transfused into other bodies, with which it is either mediately or immediately connected; tho' they being always more and more weakened, and at length becoming insensible, are farther and farther diffused over the superficies of the terrestrial hemisphere, as appears upon applying the ear to the ground, or hearing great sounds at a considerable distance; therefore, other sonorous hyperbolic rays, proceed also from other places, whereby the Archbishop's phonical sphere may be sufficiently filled.

S. *Grandio* proceeds to the second query, and gives a more general solution thereof; suppose any ray, either of light or sound, N *n* G, changed by its continual refraction, into any curve; the question is, to find by what law the density of the medium at different heights, must be supposed to be varied, that supposing the sign of refraction to be always proportional to the density of the refracting medium, that ray may be formed into the curve sought.

Let N *n* G be the axis of the curve, which the refracted ray describes; let CO be a right-line, in which taking any point C, describe with any radius CL the quadrant of a circle L *p*, and drawing any where a tangent N R, *n r*, to the refracted ray, from

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from C draw a radius parallel to the tangent, and meeting the quadrant in P, and drawing PF parallel to the axis, let it meet the ordinate NQ, perpendicular to the axis, in the point F; the curve FfF, formed hence, expreſſes by its ordinates FQ, fq, the denſities of the medium, at different heights; for CP being parallel to RN, the angle PCB will be equal to the angle which the refracted ray Nn forms with the perpendicular in the point N; and therefore, BP, or FQ will always be the ſine of refraction, taking CP for the whole line; wherefore, ſuppoſing this law of refraction, *viz.* that the ſine of refraction is proportional to the denſity of the medium, the ſame FQ will expreſs the denſity of the medium, at the height Q or N, a point equally high, thro' which the ray paſſes. Q. E. D.

In S. *Grandio*'s problem where $QN = \frac{1}{X^{\frac{1}{s}}}$; becauſe $Y^s = \frac{1}{X^s}$,

if FQ, the exponent of the denſity of air, be called Z,

Z will be $= \sqrt[s]{\frac{}{X^{2r+2s}+r}}$ or taking r and CP for

unity, then $Z = \sqrt[s]{\frac{}{X^{2+2s}+s}}$ and ſuppoſing, that the hyperbolic wave is equilateral, and conſequently the ray a ſimilar equilateral hyperbola, $y = \frac{1}{X}$ becauſe $s = 1$, Z will be $=$

$\sqrt{\frac{1}{X^4+1}}$: But becauſe, both *M. Hermannus* in *Act. Bipſ.* 1706, and Dr. *Gregory* in his *Aſtronom.* Lib. 5. demonſtrate, that the curve, which determines the degrees of the denſity of the air, is the logarithmic; ſo that the heights QQ, oq, or X are the logarithms of the exponents of the denſity of the air in the points Qq; it is plain that the curvature NG, of the continually refracted ray Nn is deſcribed by ſuch a law, as that the co-ſines of incidence, and refraction, raiſed to the power $\frac{r}{r+s}$ have a ratio compounded of the ratio of the right ſines, raiſed to the like power, and of the ratio of the logarithms of the denſities: Moreover, tho' we ſhould allow, that the common law of the refraction of light gives the ſines of incidence and refraction, proportional to the denſities of the medium's, yet that proportion may not poſſibly be ſo exact, ſeeing the ratio of the ſines in the refraction

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out of air into glaſs, is nearly ſeſquialteral, and air upwards of 1000 times more rare than glaſs; but when geometricians found that the ſine of refraction became greater, in paſſing into another medium, according to the greater facility with which light penetrates that medium in the common hypotheſis, or according to the greater difficulty, in the hypotheſis of *Des Cartes*; who, on the contrary ſuppoſes, that light ſuffers a greater refraction on account of the greater difficulty, in a rarer, than a denſer medium, (as heavy bodies, becauſe of the greater difficulty in penetrating denſer bodies, are more refracted in theſe, by receding from the perpendicular) and that both laws agree in this; *viz.* that according to the greater rarity of the medium, the greater would be the refraction; hence it came to prevail, that the ſines were ſaid to be proportional, not to the facility or difficulty of their paſſage, one or other of which is called into queſtion by ſome, but to the rarity of the medium, in which all agree, tho' the true proportion does not entirely anſwer thereto in the ſame geometrical ratio; therefore, whenever mention is made of denſity or rarity, perhaps the facility of paſſage in the common hypotheſis and difficulty in the *Carteſian*, might be ſubſtituted for it, excepting where it is ſaid, that the rarity varied by the weight of the incumbent air, anſwers to the heights, as numbers to their logarithms, which is ſtrictly true.

An Account of Roman Antiquities *found in* Yorkſhire; *and a Storm of Thunder, Lightning and Rain; by Mr.* Ralph Thoresby. Phil. Tranſ. N° 319. p. 289.

ONE of the *Roman* monuments, found at *Adellocum* was evidently an altar, having the *Diſcus* or hearth very plain on the top; another tho' exactly made in the ſhape of an altar in all other reſpects, yet wanted the *Diſcus* or *Lanx* on the top, and Mr. *Thoresby* never ſaw any without one; and it ſeemed too ſmall (being but 18 inches high and 6 broad) for a commemorative monument; the three rolls, or wreaths on the top, were ſo entire, that it was plain, that there never was any thing elſe wrought thereon: Now, whether any of the *Roman Aræ*, or *Altaria*, were made without a *Diſcus*, or hearth, Mr. *Thoresby* could not determine.

On the 5th of *Auguſt*, 1708, Mr. *Thoresby*, being at the *Spaw*, at *Harrow gate*, near *Knaresbrough*, where having a ſpacious proſpect on the open foreſt, he obſerved the motion of the clouds and ſtorm, which began in the weſt, wheeled about, by the north and eaſt, to the ſouth; when night drew on, there appeared dreadful lightning, the intermiſſion between the flaſhes being

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being very ſmall, and the claps of thunder very loud; the lightning burnt down a barn near *Scarbrough*; near *Pately-bridge*, about ſix miles from *Ripley*, one *Thomas Horner* and others, flying from the violence of the rain, which ſeemed rather to fall in ſpouts than drops, took ſhelter in a neighbouring barn; from whence, after ſeveral dreadful thunder-claps, they were expelled by the bolt, as they termed it, but really the lightning; which ſinged the hair of the ſaid *Thomas Horner*, threw another perſon backwards, who was climbing up the hay-mow, left a ſulphureous ſtench behind it, and at length, burnt down the barn and hay: The inundation was ſurpriſing, it tore up much of the road, and ſtreet, from the church of *Beverly* to the bridge, and dug pits in ſome places ſeveral yards deep, threw down part of a barn and ſtable, and ruſhed into moſt of the houſes in the town; in ſome the water was as high as the ſoles of the windows, and blocked up the door of one houſe with gravel, almoſt to the very top; ſeveral perſons were in imminent danger, but there was only one woman drowned; ſhe was hurried away by the violence of the ſtream, and not found till the fourth day after; it removed a large oak ſeveral yards off, bore down the moſt part of four wooden bridges, and left at the end of the large ſtone bridge, or within about 100 yards thereof, as much gravel, *&c.* as was computed at above 1000 cart-loads; in another place, it left a great quantity of ſtones and gravel: This ſeems very remarkable, becauſe effected by the rain alone; for notwithſtanding all this inundation, the river *Nidd* kept within its channel.

Microſcopical Obſervations *on the* Palates *of* Oxen, *&c. by M.* Leewenhoeck. Phil. Tranſ. N° 320. p. 294.

M. *Leewenhoeck* took a cow or ox's head, and cut out the roof or palate, cloſe to the throat, whilſt warm, and ſqueezing it gently, he could perceive, ſmall, round, protuberant and tranſparent drops, iſſue out of ſeveral parts thereof; and ſqueezing it a little harder ſtill, there enſued a yellowiſh liquor: He took the uppermoſt ſkin of the ſaid part, and viewing it thro' a microſcope, he obſerved, that upon moſt of the places from which the aforeſaid liquor proceeded, there was a round ring or circle, ſomewhat of a darker colour than the ſkin, or membrane that lay next it; he could likewiſe perceive ſmall holes, or orifices in ſome of the ſaid places, from which the liquor came, and theſe moiſt places were not all at equal diſtances from each other: From theſe diſcoveries he began to conſider, whether the contracted parts (which he had obſerved in the membrane, after it was ſlipped off) from

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from whence the liquor proceeded, were not valves, thro' which it was conveyed into the mouth, but none of it admitted to return the ſame way: He moreover diſcovered in the ſaid ſkin, or membrane, a vaſt number of exceeding ſmall protuberances, that ſtood cloſer to each other, than the hair upon a man's head; he likewiſe obſerved in the uppermoſt thin pellicle, holes ſo very ſmall, that they almoſt eſcaped his ſight, tho' he viewed them thro' a microſcope; for, notwithſtanding the ſkin appears to the naked eye very ſmooth, and poliſhed, yet he could diſcover ſeveral parts of it overſpread with protuberant particles, which far exceeded the above-mentioned particles in largeneſs; he judged them to be thicker at the root than a hog's briſtle, and about the diameter of the ſame in height; when theſe laſt protuberant particles were diveſted of the ſkin that lay upon them, he could perceive each of them armed with pointed particles; upon viewing the rough ſkin that lay under the thin ſkin, he likewiſe perceived therein ſlender fibres, or briſtles of a darkiſh colour, that paſſed ſtrait thro' the ſaid ſkin, correſponding with the ſmall protuberances and little orifices, he had diſcovered in the uppermoſt ſkin: From this obſervation, he imagined that the laſt mentioned orifices, and the little fibres in the thick rough part, were thoſe oblong particles that receive the juices, and alſo produce that ſenſation, called taſte; afterwards, he viewed thoſe parts, that lie under the thick rough part, and in ſome places they appeared to be nothing other than yellow and white glands, about the bigneſs of a coarſe grain of ſand; and each of theſe glandulous bodies conſiſted of a great number of ſmaller particles, with each of them a different figure, and lying involved as it were, in each other, and about the bigneſs of the particles of fat; and indeed, one would be apt to take them for ſuch; but when they were ſuffered to dry, they were ſo ſhrunk up, that one could hardly diſcover any of their parts; but upon moiſtening them again, they reſumed their former figure; whereby *M. Leewenhoeck* was convinced, that they were not particles of fat; and between the ſaid parts there ran a great number of veſſels, which he did not take for blood-veſſels; and alſo, each gland ſeemed to be ſurrounded with a membrane; the uppermoſt ſkin was covered with a very thin membrane, which was not very cloſely united thereto; and this membrane he ſuppoſes, is what is eaſily ſeparated from the ſkin that lies under it, by the hot or ſharp moiſture; he often ſeparated the ſecond ſkin, wherein the above-mentioned valves were, from that rough part, that lies under it, which may alſo be called a ſkin, and which in ſome

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ſome places was about ſix times as thick as the uppermoſt ſkin; and he as often obſerved, that the ſkin which he ſeparated, did not only always remain faſtened to the valves; but likewiſe part of the veſſels, to which the valves were united, remained ſeveral times faſtened thereto and theſe veſſels run into the figure of a cup, or funnel, that is become narrower inwards.

Plate V. Fig. 4. A B C D repreſents thro' a microſcope a ſmall particle of the above-mentioned membrane, in which the round protuberant particles are oppoſed to the ſight; E E alſo repreſents the aforeſaid valves, which are ſeldom ſo cloſe, as here ſhewn; and he ſeveral times diſcovered in the middle, that is, in the dark part of them, an orifice, which he judged to come by chance, and which is entirely ſhut up, when there are no juices conveyed out of them: He alſo diſcovered ſeveral long, ſlender, and pointed particles, which he took to be rooted, or planted in the ſkin, with a pointed extremity, and that theſe produced the above-mentioned protuberances; and tho' he did not perceive quite ſo many of theſe long particles, as he did of the protuberances, yet he concluded, that the long particles were at firſt as numerous as the other; but that a great many of them, in ſeparating the ſkin, might have remained ſticking therein, as has often happened to him in operations of the ſame nature: He afterwards obſerved, that when he diſſected the ſkin, in which the aforeſaid oblong pointed particles were ſheathed, the ſaid particles were united to the parts that lay under them, and there twice as thick as at their upper extremity, and as near as he could meaſure them by his eye, as long as four times the diameter of the hair of one's head: Now, as theſe pointed parts, which were fixed in the aforeſaid protuberances, were oppoſed to the ſight with the points uppermoſt, he could not eaſily make any obſervation on them; wherefore, he cut off one of the ſlender particles from the reſt, repreſented as it appeared thro' a microſcope by Fig. 5. F G H I; of which F G ſhews the undermoſt part, which is the ſocket as it were, of the pointed parts, and I H the ſaid pointed parts.

When he had ſeparated the ſkin of another ox's roof or palate, and cut it thro' into very thin parts, he obſerved a great many little holes, and many more parts, that were ſtopped up, wherein the long pointed particles remained ſticking; whereupon he cut it a-croſs, and obſerved, that the aforeſaid pointed particles ſtood ſo thick by each other, that there was not the breadth of a hair between them: Having obſerved that the roof of the ſaid ox was cloſely united to the bone, that lay under it, he examined the

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the external part of that bone, and with wonder diſcovered therein ſo many pores, or holes, as ſtood cloſer to each other, than the hair of one's head; however, he perceived a great many of them ſo cloſely ſhut up, that he could diſcover no aperture in them; and the largeſt of thoſe pores (which were but few in number) were as big as the diameter of the hair of one's head, and in one of them there alſo ſeemed to be a blood-veſſel.

M. *Leewenhoeck*, examining the inner parts of the noſtrils of a cow, or ox, obſerved that each ſide of the mouth (which may be called the lips) was furniſhed with a great many pointed particles, that were very thick in the inner ſkin, and being round, ran into a very ſlender point; he alſo made his obſervations upon the ſkin of ſeveral of the ſaid parts, which were very ſtrongly united to the parts that lay under them, and he found that one of thoſe parts that lay within, conſiſted of a great many pointed particles, much thicker and longer, than thoſe he had diſcovered in the inner parts of the tongue of an ox, or hog.

Fig. 6. K L M N repreſents as it appeared to the naked eye, a very ſmall particle of the above-mentioned parts, only that it is not ſo thick, and large as it ſhould be, its parts having been dried and ſhrunk up, and beſides, it was of the ſmalleſt ſize of any he had diſſected.

Fig. 7. O P Q R S T repreſents a very ſmall piece of the above-mentioned particle, ſtripped of its ſecond ſkin, and in which ſome of the pointed parts were ſtanding out, but moſt of them lay cloſe upon the ſaid particle; he obſerved, that that pointed part, repreſented by S, ſtood out farther than the reſt, and that it conſiſted of ſeveral long particles united together, the longeſt of which ſtood out beyond the reſt, and ran into ſuch ſharp points, that they appeared thro' the microſcope, as the point of the ſmalleſt needle does to the naked eye; and the reaſon why we cannot always ſee theſe ſharp pointed particles is, as M. *Leewenhoeck* ſuppoſes, becauſe they are ſo united to the two ſkins, with which they are covered as it were, that they cannot be ſeparated therefrom, without leaving ſome particles ſticking in one part or other; he likewiſe obſerved ſome particles, whoſe extremities conſiſted of four diſtinct points of equal length: In ſome of thoſe ſharp pointed particles, as repreſented in the laſt figure by Q and R he could very plainly ſee, that each of them conſiſted of three long particles, and that in the middle the longeſt; from whence he conſidered, whether each of thoſe long particles conſiſted of other long particles, which on account of their exceeding ſmallneſs, might eſcape his ſight: M. *Leewen-*

hoeck

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Loeck found, that the thinneſt part of an ox's tongue conſiſts of bony particles, and that in thoſe parts, there is no taſte; now we know, that an ox in chewing his food, does not only grind it, by opening and ſhutting his mouth, but by the continual motion of the lower jaw, from the left to the right ſide, turns it over the hindermoſt teeth, by which the food is ſtill more broken, and ground, than it could be by the direct opening and ſhutting of the mouth, as aforeſaid; now if we ſuppoſe that by the abovementioned motion, the food is conveyed amongſt the various parts, a ſmall particle of which has been repreſented by K L M N Fig. 6. and that thoſe parts, by the motion of the mouth, cauſe ſuch a preſſing, or kneading of the particles of the food lying amongſt them; the ſaid food is inſinuated, as it were into the parts, and by this means a ſtronger ſenſation of taſte produced in chewing it again, than the tongue felt at firſt; and thus, what is wanting in the tongue to reliſh the taſte, is doubly compenſated to it, by thoſe parts in the ſide of the mouth: He diſcovered a vaſt many ſmaller pointed particles lying in the ſkin between the greater particles, and faſtened in the lower parts, and as cloſe to each other as the hair of one's head; the points of theſe ſeemed to him to be moſtly obtuſe; afterwards, he obſerved, that a great many of them were thick, cloſe at the root, and that their uppermoſt part was thrice as ſlender as the lowermoſt; from which diſcovery he concluded, that they were all of them of ſuch a figure, and that in ſeparating them from the ſkin, moſt of the ſlender parts were broken off, and left ſticking therein; and when he traced them into the under parts, he found that they were thrice as long, as where they had lain in the ſkin, that was taken off; and where they terminated in a great number of very ſmall veſſels, they were alſo about four times as thick, as where they were fixed in the ſkin: M. *Leewenhoeck* thought, that as he ſuppoſes the ſaid particles to be endued with a little of the juices of the food, which we call *taſte*, whether each of thoſe particles might not imbibe a ſmall quantity of thoſe juices, and convey them ſo far, till they arrived at the exceeding ſmall and ſlender blood-veſſels, called the veins; and whether theſe juices are filtrated or ſtrained, as it were thro' the coats of the veins, and ſo conveyed to the heart, and thus the body receives a little nouriſhment from the mouth; now if each of thoſe particles in the mouth ſhould in the ſpace of an hour derive down to the body no more than the thouſandth part of a very ſmall drop of the juice of that food, which the ox eats or chews,

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firſt frozen water of a very pale purple, in compariſon of the middle part; which when he had taken out of the glaſs, and broken it, he found that it was frozen thro; but of ſo dark a colour in the middle, that it came near a black.

An Experiment of weighing in common Water *Bodies of the ſame ſpecies, and of an equal Weight in common* Air, *but of very unequal Surfaces; by the Same.* Phil. Tranſ. N° 320. p. 306.

MR. *Hauksbee* took an exact ſquare inch of ſheet-braſs (which is more ſolid and cloſe, than what is caſt) weighing juſt 482 grains; he afterwards cut ſquare inches of braſs-tinſel, of the ſame weight, and to the number of 255: Now theſe being of an equal weight with the other ſingle piece in common air, he concluded from the inequality of their ſurfaces, that a conſiderable diſproportion in their ſpecific gravities would enſue, upon weighing them in water, which would touch ſo many parts of the ſuperficies in one, more than in the other; and from what is generally aſſerted, that the ſmaller the bodies are, the diſproportion of their bulk to their ſuperficies increaſes; and that ſuppoſing them infinitely ſmall, as gold diſſolved in *Aqua regia*, or ſilver in *Aqua fortis*, that then their ſuperficies are touched in ſo many points by the containing menſtruum, as is in ſuch a diſproportion to their diameters, or bulk of matter, as diſpoſes them to remain ſuſpended therein; this he takes to be the general ſolution of that phænomenon; yet when he came to bring it to the teſt, he was ſurpriſed to find no more than two grains difference, the ſingle piece weighing in the water about 422 grains, and all the other bodies together, hardly two grains leſs; and this upon two or three accurate trials ſucceeded alike: Now ſince there is ſo ſmall an inequality between bodies of the ſame ſpecies, weighed in water, whoſe diſproportion of ſurfaces is, as 1 to 255 (for he reckons the ſides of all the tinſel bodies to be equal to the ſides of the ſingle braſs-piece) he concludes, that thoſe bodies muſt be infinitely ſmall, whoſe inequality of ſurfaces to their bulks exceeds theſe in this experiment; for ſuppoſing one of theſe thin ſquares to be wrought into the form of a globe, he is very apt to think, that then the diſproportion of its ſurface to its bulk of matter would not be ſo great, as in its preſent figure: Moreover, that tho' the diſproportion of the ſurfaces of bodies, to their bulk of matter, be very great; yet, that this ſhould be the only reaſon, why a metallic body ſhould be ſuſpended in a menſtruum, ſpecifically lighter than itſelf, is very doubt-

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doubtful; for certainly, if it was so, we might reasonably expect to meet with a much greater difference in the bodies employed in the above experiment; for there it should seem necessary, that where we had so great a difference in point of superficies, we should also have had a difference somewhat proportional, in point of weight, which yet was far from being so; and therefore, Mr. *Hauksbee* thinks there must be some other agent, or quality in this case: What we call a corroding menstruum, Mr. *Hauksbee* takes to be a fluid adapted to attract such, or such a body, as we find that none of them operate alike on all but *Aqua regia* is adapted to separate the parts of gold, and *Aqua fortis* those of silver: Now this separation of their parts seems to proceed from a mutual attraction between the menstruum and the immersed body, and both of them seem to act on each other with greater vigour, than than either of their own particles do upon their contiguous ones; by which means a separation of parts must consequently ensue; and thus being at liberty, they become one body with the menstruum, and by their mutual attraction remain suspended in any part thereof; and in this case that one menstruum should affect one body more than another, is nothing more extraordinary than why the magnet should affect iron only.

An Account of Inundations, *monstrous* Births, *Appearances in the* Heavens, *&c. by Mr.* Neve, *with Observations on a* Solar Eclipse; *by Mr.* Derham. Phil. Trans. N° 320. p. 308.

ON the 7th of *October* 1706, after a very rainy day, and a southerly wind, there happened a prodigious flood, which broke down several bridges, and the sides of some of the mountains in the north of *Ireland*; it came down in vast torrents from some of the mountains, and drowned a great number of black cattle and sheep, spoiled a great deal of corn, and hay in the stacks, laid several houses two or three foot deep under water, and broke down several forge and mill-dams.

On the 3d of *July* 1707, they had also another flood, which came so suddenly down from the mountains, as if there had been some great eruption of water; and on the 26th, in the county of *Antrim*, there was a very sudden, and surprising flood, which swelled the *Six-mile* river, to such a pitch, as to break down two strong stone bridges, and three houses, and carry away 600 pieces of linen, that lay bleaching; it filled a great many houses several foot deep with water, tore down some large rocks in its passage, and left several meadows covered a foot, or two deep in sand;

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ſand; in the ſouth-eaſt part of the county of *Derry* they had that day but little rain, with ſome thunder; but beyond the mountains, in the north-weſt part of the county, there was a great flood in the river *Roe*.

In 1706 a cow within a mile of the city of *Derry*, calv'd ſix living calves.

In the ſame year there was a monſtrous human birth at *London-derry*, with two heads, four arms, and but one body at the navel; it was of both ſexes, female on the right, and male on the left ſide; the right hand of the male was behind the female's back, and the left hand of the female behind the male's back, thus embracing each other; this child, or theſe children were born alive, but lived but a little while.

On *Sunday*, the 16th of *November*, 1707, after a froſty morning, and fair ſtill day, the wind at north-weſt, about ½ an hour after 8 in the evening, there appeared a very ſtrange light in the north, called by ſome the northern ſtreaming; the evening was clear and ſtar-light, only the horizon was darkened with condenſed vapours in the north, reaching about 10 or 15 degrees above the horizon; from this cloud proceeded ſeveral ſtreams, or rays of light, reſembling the tail of ſome comets, broad below, and terminating in points above; ſome of them extended almoſt to the tail of *Urſa minor*, and all of them were nearly perpendicular to the horizon, and as bright, as if the full moon had been riſing in the cloud; but what was moſt ſurpriſing, was the motion of the dark and lighter parts running ſtrangely thro' each other in a moment, ſometimes to the eaſt, and ſometimes to the weſt; it continued about ¼ of an hour, after Mr. *Neve* firſt ſaw it, often changing its appearance, both as to figure and light, being ſometimes broken, at other times entire; and there were ſeen long rays of light in the clear ſky, quite ſeparated from, and above the cloud and none below in the cloud.

Mr. *Derham* obſerves, that this light which Mr. *Neve* ſaw, is very different from that reſembling the tail of a comet, ſeen in the conſtellation of *Taurus*, or near it, in 1706, and called by ſome *Aurora Borealis*, a name he thinks better befitting this northern light, which is ſeldom, if ever ſeen out of the north.

Mr. *Derham* obſerved an eclipſe of the ſun at *Upminſter*, on *September* the 3d in the morning.

The

The correct apparent Time.			
h.	′	″	
			The beginning of the eclipſe he could not ſee for clouds.
6	44	15	The ſun peeped out of the clouds, and he judged by the eye, that about one tenth of a digit was eclipſed.
			Then clouds almoſt all the time of the eclipſe; but at
8	31	15	A little obſcuration appeared thro' the teleſcope.
8	32	45	A very little obſcuration thro' the teleſcope, then clouds, and at
8	35	45	He could diſcern no remains of the eclipſe thro' the teleſcope.

From theſe obſervations he ſuppoſes, that the end of this ſolar eclipſe, was much about 8 h. 33′ in the morning.

An eclipſe of the moon obſerved at *Upminſter*, the 18th of *September* in the evening.

As Mr. *Derham* was that evening coming from *London*, he obſerved for half an hour or more, a thin ſhade poſſeſs that part of the diſk, where the eclipſe began, which remained a good while after the eclipſe was over.

After he got home, he made the following obſervations with his teleſcopes.

The correct apparent Time.			
h.	′	″	
7	56	30	A thin *Penumbra*.
7	57	40	A darker *Penumbra*.
7	59	00	Still darker, which may be taken for the beginning of the eclipſe.
8	00	00	The eclipſe undoubtedly begun.
9	1	00	The lucid parts of the moon, not long before the middle of the eclipſe, were 925 parts of his micrometer.

The

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The correct apparent Time.			
h.	′	″	
9	16	40	The diameter of the moon 1634 parts of the micrometer.
10	23	11	The end of the eclipse drew nigh.
10	25	00	A little obscuration.
10	26	00	Less.
10	28	15	A very little, excepting the duskishness abovementioned.

An Account of some Roman Antiquities *in* Yorkshire; *by Mr.* Ralph Thoresby. Phil. Trans. N° 320. p. 314.

AMONGST the ruins upon *Adel* or *Echop-moor*, there were found some *Roman* monuments, which had no legible inscriptions; they were 18 inches high, and only 6 inches broad, of a very coarse stone, as Dr. *Lister* has rightly observed, that most of those found in the north are; one of these, as plainly appeared by the *Discus*, was one of their portable altars; but it is certain, that another having instead of the hearth, three entire rolls or wreaths, was never designed for that purpose.

When the *Vestigia* of this *Roman* station were first discovered (of which *vide Phil. Trans.* N° 282) Mr. *Thoresby* was apt to take it for the *Adellocum* of the ancients, from some remains of the name in the present *Adle*, or *Adel*, as it is writ, both in the *Monastic. Anglican.* and some ancient charts; but having afterwards an opportunity of perusing the *Domesday* book, in the *Exchequer* at *London*, he found, besides *Adele* and *Echope* abovementioned, another place in the neighbourhood, called *Burgheburum* or *Burgdunum*, which he is apt to conclude, was the ancient *Roman* name of this station: That the itinerary is silent herein, is no argument against it; for the names of all the towns in the province are not there recited, only such as lie upon those roads, that are particularly mentioned; but that it has at least, the appearance of a *Roman* name may be argued, because, *Burgi* was the common name by which they called such castles, or forts, as were convenient for war, and well stored with provisions of corn, as appears by the authorities quoted by *Cambden*, and *Burton* in their notes on the *Roman Verteræ*, or *Burgh* under *Stanemoor*; and the *Burgundians* received their name from their inhabiting such castles; and it seems probable to Mr. *Thoresby*, that the

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the small square stones, of which the very antique church at *Adel* is built, were brought from the ruins of such a castle, and thereby gave rise to an old tradition, which continues to this day; viz. *That* Adel *Church stood once upon* Black-hill, the place where these *Roman* monuments were found; the elevated situation of the place sufficiently accounts for the termination of the name, the *Gallish* or *British Dunum*, which signifies a hilly or mountainous place, and which was naturalized into the *Roman* provincial language; within a mile of it, there are two scattering houses, that to this day retain the name of *Burden* for *Burgdunhead*.

An Account of the Icy Mountains *of* Switzerland; *by Mr.* Will. Burnet. Phil. Trans. N° 320. p. 316.

AT the *Grindlewald*, a mountain two days journey from *Bern*, Mr. *Burnet* saw, between two other mountains, a river of ice, as it were, which divides itself into two branches, and in its way from the top to the bottom of the mountains, swells into vast heaps, of a prodigious bigness; the original of which seems to have been this, *viz.* the tops of these mountains are covered with snow all the year round, this snow melts in the summer, and falls to the bottom, where the sun never reaches, there it is frozen, which happens more easily to melted snow, than common water; thus it has encreased every year, 'till it has reached the very top; the reason why the water has always frozen, tho' the sun shines upon the middle of the mountain, and higher up, some part of the day, is, that the melted water runs under the ice, already formed, and freezes there, and so expanding itself, raises the ice above it, and sometimes makes it crack, so as to frighten the whole neighbourhood; and the reason plainly appears, because the upper surface being solid, cannot be dilated, without making great chinks, and that with a terrible noise; Mr. *Burnet* was told upon the place, that the mountain increases every seven years, and decreases the next seven years; but he doubts the truth of that observation; and if there is any foundation for it, it seems to be this, *viz.* that in the hottest summers it increases, and in more moderate summers decreases, there being then less snow melted.

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An Account of a Muſket-bullet, *and the ſtrange Manner of its coming out of the Head, where it had lain near* 30 *Years; by Dr.* Robert Fielding. Phil. Tranſ. N° 320. p. 317.

AT the firſt *Newbury* fight, in the time of the late civil wars, Dr. *Fielding* was ſhot on the *Os petroſum* near the right-eye, he had likewiſe his ſkull broken, with a great effuſion of blood from the wound, mouth and noſtrils: The ſurgeon probing the wound for the diſcovery of the bullet, but to no purpoſe; on the third day after receiving the ſhot, placed him horizontally to the ſun, by which means depreſſing the fractured ſcull with the probe, he could ſee the pulſation of the brain, but not diſcover the bullet; when the Dr. began to grow cold, his mouth cloſed up, and continued ſo for the ſpace of half a year, till ſeveral ſplinters of bone came out of the wound, mouth and noſtrils; and afterwards, whenever a ſplinter was to come away, his mouth would cloſe, inſomuch, that ſeveral years after, he prognoſticated to ſome friends, that a bone was then coming out, which continued ſo for ſix or ſeven weeks, at which time finding an itching in the orifice of the wound, he felt a bone with his finger, and extracting it, being no bigger than a pin's head, he immediately opened his mouth: At the ſecond *Newbury* fight it healed up, and no art could keep it open; afterwards, for the ſpace of 10 years or more, there was a flux of ſanious matter from the right noſtril, and ceaſing there, it flowed for ſome years from the left; at length for the ſpace of two years, or thereabouts, the Dr. upon riding, would ſometimes feel a pain on the left ſide, about the almonds of the ear, cauſing a kind of deafneſs, which he attributed to cold, but more eſpecially after riding in a cold dark night; and having ſtopped his ear with wool to recover his hearing, one day in *March* or *April*, 1670, it gave ſuch a ſudden puff or crack, as made him ſtart; upon this, all that ſide of the cheek hung looſe, as if it had been paralytic, and a hard knot might be felt under the ear; afterwards, ſeveral tumours ſucceeded each other on that ſide under the jaw bone, which made him conſult two phyſicians, one of which ſuſpecting the bullet, but conſidering the ſhot, they did not think it probable; at length the tumours coming to the throat, if he held up his head, but a little, it ſeemed as if one with a hook pulled down the jaw-bone, and if any thing touched the throat, it was as painful, as if pricked with needles; the Dr. being at laſt perſuaded to make ſome applications, a ſmall hole appeared, afterwards another, and then a third, near the

Pomum

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Pomum Adami; by these the bullet was discovered, and extracted in *August* 1672.

An Experiment, shewing that actual Sound *cannot be transmitted thro' a* Vacuum; *by Mr.* Francis Hauksbee. Phil Trans. N° 321. p. 367.

TO answer the following query, *viz.* Whether the sonorous body in such a *Medium*, as a *Vacuum*, might not suffer in such a manner, or undergo such a change in its parts, as to be rendered uncapable of being put into such a motion, as is requisite for the action, or production of sound? Mr. *Hauksbee* contrived the following experiment; he took a strong receiver, arm'd with a brass-hoop at bottom, in which he included a bell, as large as it could well contain; he strongly screwed down this receiver full of common air, to a brass-plate, with a wet leather between them; being thus secured, it was set on the pump, where it was covered with another large receiver; and in this manner the air, contained between the outer and inner receivers, was exhausted; and the clapper being made to strike the bell, Mr. *Hauksbee* found, that the sound was not transmitted thro' the *Vacuum*, tho' he was sure there was actual sound produced in the inner receiver: And this plainly shews that air is the only medium for the propagation of sound.

An Experiment shewing the Propagation of Sound, *transmitted from the sonorous Body to the common Air, in one Direction only; by the Same.* Phil. Trans. N° 321. p. 369.

MR. *Hauksbee* in order to try whether sound (propagated in a receiver, having a communication with the open air, at one small aperture only, but otherwise entirely surrounded by a *Vacuum*) would be increased, or continue sounding longer, at each stroke, that should be given the bell, than it would do, were not its body encompassed with such a medium, he included the bell, as in the former experiment; only to the upper part of its receiver, a box was screwed, with collars of leather, and on the top of the outer receiver, a brass-plate was laid, with a wet leather between, and to the middle of this plate, was likewise screwed another brass box with collars as before; these receivers when placed on the pump, had their boxes standing directly one over the other; thro' both of them in that position, he passed a hollow brass-tube, which exactly fitted their perforations; thus, the inner receiver had a communication with the external air, and

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the outer receiver was thereby ſecured from the ingreſs of the circumambient medium: Now, when the air contained between the receivers was pretty well exhauſted, and the bell ſtruck, the ſound was ſenſibly very vigorous, and nearly as great, as when no air at all was exhauſted; yet if one's finger was applied to the aperture of the hollow braſs tube, the ſound would be ſo much impaired, as but juſt to be diſtinguiſhed: By this we ſee, that tho' ſound, in that ſtate, cannot be tranſmitted thro' the receiver, that includes it, by means of the circumambient *Vacuum*, yet the receiver is certainly ſtruck therewith; but finding no conveyance that way, it reverberates, and makes its paſſage where it finds the leaſt reſiſtance; nor did Mr. *Hauksbee* obſerve, that tho' the ſound had but one paſſage, and that but a ſmall one, from its receiver, that it continued any longer after the ſtroke, than if it had been made in the open air.

An Experiment on the propagation of Sound *thro'* Water; *by the Same.* Phil. Tranſ. N° 321. p. 371.

AS in the former experiment, the receiver which contained the bell was ſcrewed down to a braſs-plate, with leathers between; ſo in this it was with its bell ſuſpended, in a large glaſs-veſſel, by four twine threads to the top, and as many to the bottom, whereby it hung in the middle between both; concluding, that theſe threads would abſorb the water, when it came to be poured in, in ſuch a manner, that no ſound ſhould be conveyed by them from the ſonorous body, any more than if they were entirely water; being thus provided, the clapper was made to ſtrike the bell, whoſe ſound was ſomewhat leſs by the interpoſition of the glaſs, than it would be, had it been made in the open air; however it was very audible, and might be heard at a conſiderable diſtance; it appeared to the ear to be very harſh, in reſpect of the tone it yielded; but now, when the water came to be poured in, and the inner receiver ſurrounded by it, at leaſt an inch and an half from the neareſt part of the outer glaſs, the clapper was again made to ſtrike; and the ſound was ſeemingly, very little leſs, in reſpect to its audibility, but much ſweeter and graver, at leaſt two or three notes deeper, than it was before.

An

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An explanation of the Figure of a Pagan Temple, *at* Cannara *in* Salſet; *by Mr.* Alexander Stuart. Phil. Tranſ. N° 324. p. 372.

PLATE V. Fig. 10. repreſents the rocky mountain *Cannara* in the iſland of *Salſet*, belonging to the *Portugueſe*, with the temple and caverns; A the temple, and ſacrificing place, like the choir of a church, arched and ſupported by 45 pillars, all cut out of the rock; B the altar in the farthermoſt end thereof, likewiſe cut out of the rock, with a narrow canal, about the foot of it, which Mr. *Stuart* ſuppoſes, was deſigned to be filled with water; DDD the various irregular paths of aſcent, ſome cut out in ſteps, reſembling ſtairs; 1, 2, 3, *&c.* the various caverns, moſtly of a ſquare figure, ſome larger, others ſmaller, cut out of the rock, whoſe roofs are cut plane, like a plaiſtered room; at the door of each on the outſide, is a large ciſtern, or two, cut out of the rock, and full of rain water; at leaſt Mr. *Stuart* could not perceive them to be ſprings.

Experiments made on Metals, *with the Duke of* Orleans's *burning* Glaſs; *by M.* Geoffroy. Phil. Tranſ. N° 322. p. 374.

THIS burning glaſs is three foot in diameter, collecting the rays of the ſun at 10 foot diſtance, where it forms a *Focus* of about three inches over, which is again contracted, by means of another glaſs *Lens* into an inch in diameter, and conſequently, is rendered three times as ſtrong; its heat and efficacy far ſurpaſſing the force of our common fire: What was a great hindrance to M. *Geoffroy* in making theſe experiments in the *Focus* of this glaſs, was the difficulty he had of finding any ſubſtance capable of holding the metals in fuſion; charcoal, which is commonly made uſe of, is indeed a very proper ſubſtance, but it is impoſſible therewith to vitrify any one of the metals; the particles of the metal, when held any long time in fuſion, in the *Focus* of the glaſs, are diſſipated, and fly away in fume, or ſmall particles; the reaſon of which he takes to be this; charcoal is a ſubſtance deeply impregnated with oily, or ſulphureous particles; the firſt effect that fire has on metals is to ſeparate the ſulphureous particles; now, if in proportion as the ſulphur is ſeparated from the metal, the body that ſupports the metal, furniſh it anew with other ſulphureous particles, the other principles will never ſeparate, and the metal will always remain metal, and nothing but the greateſt degree of fire can raiſe, and ſeparate

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ſeparate the ſulphur, and that but gradually, and in very ſmall particles: M. *Tſchirnhauſen*, to whom we are indebted for the making of theſe large glaſſes, and the firſt experiments that were made with them, ſays, he had vitrified metals by holding them in *China* ware; it is true, this ſucceeds pretty well, provided the pieces be very thick, and the glazing taken off: Of all the different ſorts of matter M. *Geoffroy* made trial of, what ſeemed beſt were the common coppels, and plates of gray fire-ſtone; the coppels hold the metal a long time in fuſion, in the *Focus* of the glaſs, without melting, excepting lead, which eaſily runs thro' them, as ſoon as it vitrifies, and helps to diſſolve them; the plates of the fire-ſtone bear the heat of the *Focus* much longer than any other ſubſtance; but great care is to be taken in heating them without breaking, till they become red hot, and when they are ſo, the leaſt cold air makes them melt: Another thing requiſite in making theſe experiments is, a bright ſtrong, and conſtant ſun at noon, to keep the matter a long time in perfect fuſion.

M. *Geoffroy* placed in the *Focus* of the burning glaſs a piece of forged iron, about a drachm weight; it became red hot, and its ſurface was covered with a black matter, like pitch, or tar; and upon withdrawing the iron, in this ſtate, out of the *Focus*, this matter would fix itſelf on the ſurface of the metal, and there form a ſmall film, or very fine blackiſh ſcale, which is commonly very eaſily ſeparated, by ſtriking upon it; and that part of the iron, covered with this ſcale, appeared blacker than ordinary; this ſcale is ſome of the ſulphureous part of the iron, that riſes to the ſurface of the metal when ready to melt, and remains there for ſome time, before it evaporates; it is plainly, this ſulphureous part that riſes upon iron, and poliſhed ſteel, when heated, and gives them all thoſe different colours, from a yellow to a violet, a water colour, or black; if one continue to hold this piece of iron on the charcoal, it entirely melts, and at the ſame time emits very bright ſparkles in great quantities, ſometimes to upwards of a foot diſtance from the coal; if one ſhould ſave what flies off, during this ſparkling, by holding a ſheet of paper under the coal, he will find that they are ſo many ſmall globules of iron, and the greateſt part of them hollow; all the iron, that is held in fuſion upon the coal, flies away in ſparkles after this manner, till none remain; ſometimes the metal leaves off ſparkling, when the coal is partly conſumed, and covered with a bed of cinders, upon which the melted iron lies; for as the ſparkling of the iron ſeems to proceed from nothing other than

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than the oily parts of the coal acting upon thoſe of the metal, the cinders hinder this oil from paſſing from the coal to the iron, ſo that it remains quietly in fuſion; but if by a ſhake, or the like accident, the cinders be ſo removed, that the iron comes to immediate contact with the coal it will begin to ſparkle afreſh; ſometimes the heat, that keeps the metal in fuſion, does alſo vitrify the cinders, and this vitrified matter mixing with the metal makes a conſiderable ebullition; and if at this inſtant you withdraw the metal out of the *Focus*, it will appear half vitrified, or reduced to a blackiſh friable maſs; at other times this vitrified matter ſwims on the ſurface of the metal, and there forms itſelf into drops, that are ſometimes clear and tranſparent, and at other times opaque, according as it is more or leſs mixed with the metal; moreover, if after having let the melted iron cool upon the coal, one expoſe it again to the *Focus* of the glaſs upon the ſtone, it ſparkles afreſh, till it is all conſumed, which common iron will not do, that has not been expoſed to the heat of the *Focus* upon charcoal, this ſparkling probably proceeds from the ſudden rarefaction of the oily parts of the coal, with which the pores of the iron are ſo plentifully ſaturated; or perhaps it may be cauſed by the ſalts of the iron acting on the oil of the coal: Upon expoſing iron and ſteel to the *Focus*, upon a ſlate ſtone, they grew red hot, and melted without crackling, or emitting any ſparkles; they ſmoaked very conſiderably, and the melted metal became gradually like an oil; after withdrawing this melted matter out of the *Focus*, it fixed itſelf into a friable maſs like a *Regulus*, and appeared ſometimes lightly ſtriated, or ſhot into ſharp points like needles; tho' this matter does not at all appear tranſparent, yet we may look upon it, as the beginning of vitrification, or a middle ſtate between metal and glaſs; for it would at laſt vitrify, like other metals, if one could hold it a ſufficient time in the *Focus* without melting, or mixing, with what ſuſtains it; but continuing it long in the *Focus*, the extreme heat of the ſun, that is neceſſary to keep it in perfect fuſion, does likewiſe melt the ſtone, or coppel, that contains it, the reſult of which mixture is a brown, or greyiſh ſort of enamel; we may then take this *Regulus* to be a half vitrified iron, becauſe it is deprived of a great part of its ſulphur; and if you add to this maſs a ſulphur, like that taken from it, from being friable it becomes very hard, and malleable, and its former dullneſs changes to the brightneſs of a metal; this he found in expoſing again this matter to the *Focus*, upon charcoal; it melts, and ſo continues a conſiderable time in fuſion without

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without ſparkling, but at laſt it ſparkles with the ſame briſkneſs as iron itſelf, and when withdrawn from the *Focus*, ſeems no ways different from melted iron: it appears from theſe experiments, that iron contains a ſulphur, or oily ſubſtance, that renders it bright, malleable, and eaſy to melt: That this ſulphur is raiſed by the fire of the ſun, when the metal is for ſome time held in fuſion in the *Focus* of the glaſs: That this ſame ſulphur may be raiſed by the flame of common fire, which tho' not ſtrong enough to melt the iron, yet can reduce it to an eſchar, or ſort of ruſt: That iron deprived of this ſulphureous part, melts into a regulus, or brittle and friable maſs, in colour much like antimony: That if one could hold a ſufficient quantity of this matter long enough in the *Focus* by itſelf, without melting, or mixing with the body that contains it, it would perfectly vitrify: That this glaſs or metallic regulus, with the addition of a little oil, returns to its former ſtate of a metal: That it re-aſſumes this metallic form upon charcoal, by drawing from it this oily ſubſtance: That in ſhort, this oily part contained in the coal, is little different from the ſulphur of iron; nevertheleſs, we muſt ſuppoſe it different in ſome particulars; *viz.* in regard that melted iron, that has been ſaturated with it, crackles and ſparkles very much, when melted again upon the ſtone, or coppel: Iron being the only metal in which M. *Geoffroy* obſerved this ſparkling, he takes it to be a property, peculiar only to iron, and not to any other metal; perhaps, we may attribute it to the vitriolic ſalt, that this metal is ſo plentifully impregnated with, which abſorbs ſulphur; and to this quality of the vitriolic ſalt of iron, we may alſo attribute the facility with which iron conſumes the coal; for there is no other metal, that waſtes the coal in the *Focus* of the glaſs, ſo ſoon as iron does: Iron is the only one of the four imperfect metals, on which vitrified drops ariſe, while in fuſion upon the coal, the reaſon of which M. *Geoffroy* could not hitherto diſcover.

Copper expoſed to the *Focus* of the burning-glaſs, does at firſt turn white on its ſurface, and afterwards black and is covered with a kind of ſkin, or with black, furrowed, and uneven ſcales, 'till at laſt it quite melts: M. *Geoffroy* withdrew this metal out of the *Focus*, as ſoon as this white colour appeared, and after it was cold, he found nothing extraordinary on its ſurface, but by degrees it recovered again very nearly its former colour; nor could he diſcover whence this white colour proceeded, unleſs we may attribute it to ſome volatile arſenical ſalts, contained in the copper, and driven by the extremity of heat to the ſurface of the metal; or purely to the alteration made in the groſſer parts of the ſurface of

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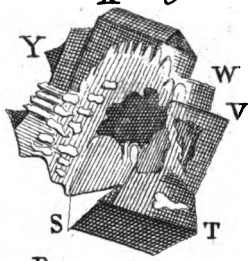
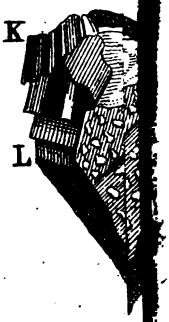
Fig. IV.





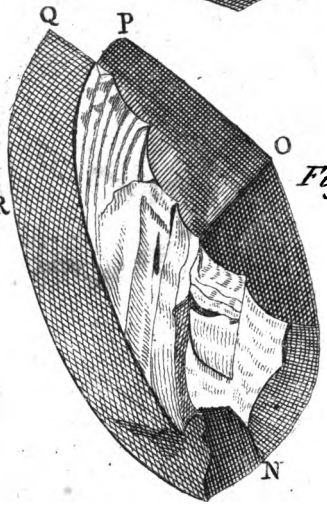


Fig. III.

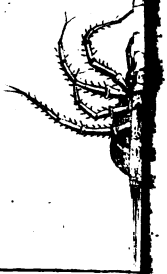


Fig. XVI.

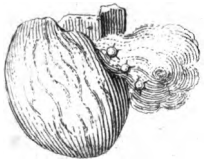


Fig. XVII.

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of the metal, when it begins to melt: The black colour, copper afterwards assumes, seems to arise from the sulphureous matter, that melts first in this metal, as well as in iron, and which is raised to its surface by the extreme heat: M. *Geoffroy* placing in the *Focus* a piece of copper upon charcoal, it melted and emitted a very thin fume, which diminished gradually, till it was quite evaporated: Upon putting into the *Focus* of the glass a piece of red copper on a coppel, it melted and emitted, some thin fumes, and after being for some time in fusion, it became liquid like an oil; he withdrew this melted matter, and as it became cold, it fixed into a *Regulus* of a reddish brown colour, which was hard, brittle, and unmalleable; when broken it would become a red powder, resembling cinnabar of antimony, and viewed with a microscope, there would appear so many small, red, transparent grains, like small rubies; insomuch, that one would readily take this *Regulus* for a deep coloured red glass: M. *Geoffroy* endeavoured to make this vitrified copper spread abroad in melting, by mixing it with common white glass; for which end he powdered some of this vitrified copper, and common glass, and mixing them he melted them together; but the mixture, when in fusion, assumed at a first a beautiful green colour, and continuing it longer in the *Focus*, it turned blueish; M. *Geoffroy* supposes, that we may ascribe this change of colour to the alcalious salts of the glass, acting on the particles of copper; for these salts usually draw a green, or blueish tincture from this metal: To preserve therefore this red colour of the vitrified copper, when mixed with common glass, he made use of this expedient; he melted in the *Focus*, a piece of copper upon a coppel, and as soon as it began to vitrify, he cast thereon some common glass, and as soon as the glass was melted, he took them together out of the *Focus*, without confounding them; and when cold, he separated the *Regulus* from the glass, as well as he could, and pick'd out of it some pieces of the glass, charged with some very small, red, transparent particles of the *Regulus*: This vitrified copper is then no other than copper deprived, by means of heat, of the sulphureous particles, that gave it the form of a metal; for if you expose to the *Focus* this vitrified copper upon charcoal, it re-assumes in a little time the colour and consistence of melted copper, and as it becomes cold, fixes into a good, red, malleable copper, as fine and hard, as it was before vitrification.

From these experiments it follows, that the basis of copper is a red earth susceptible of vitrification: That this earth receives its

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metallic form from a ſulphureous ſubſtance, in appearance no ways different from the oil either of vegetables or animals: That copper may be deprived of this oil, by holding it long enough in the *Focus*, or by calcining it in the flame of common fire: That charcoal reſtores again this oily part to the copper, and at the ſame time its metallic form: It farther appears, that the oil of the coal has not ſo conſiderable an effect on copper, as on iron: Copper put upon a ſtone, or coppel, and expoſed a long time to the *Focus*, fumes very much, and diminiſhes very conſiderably in weight: M. *Geoffroy* does not think, that this fume is only the ſulphureous part of the metal, the evaporation of which muſt be inſenſible; but that with this oil there is mixed a great deal of the earthy, vitrifiable part of the metal, which the heat of the ſun ſublimes, and raiſes in flowers.

Tin, expoſed upon coals to the *Focus* of the burning glaſs, melts and emits a groſs, white, thick fume, till it is all evaporated: If you melt tin upon a coppel, in the *Focus* of the glaſs, it fumes very much, and its ſurface is covered with a white rarified *Calx*, on which gradually ariſes a tuft, or heap of ſharp, tranſparent, cryſtalline particles, conſiſting of a vaſt many ſmall points: If you continue to hold this maſs in the *Focus* upon the ſtone, theſe cryſtals do at length ceaſe fuming, and remain fixed, whilſt the ſtone melts and vitrifies: M. *Geoffroy* took *Calx* of tin (which is tin reduced to a grey powder, by means of fire, that has taken away by calcination, great part of its oily ſubſtance) and expoſed it on a coppel to the *Focus*, where it fumed again very much, and was reduced into ſharp cryſtalline particles, conſiſting of other ſmall points; upon re expoſing to the *Focus* theſe cryſtalline particles upon charcoal, they melted very eaſily, and aſſumed again the form of tin, the coal having furniſhed them with the ſulphureous part, that the fire had before taken away; for it is well known, that adding any fat, or other inflammable matter to the *Calx* of tin, when red hot in the crucible, it immediately re-aſſumes the form of tin: Theſe experiments ſhew, that tin contains a ſulphur, that is very eaſily ſeparated, ſince common fire can do it ſo readily; and that this metal calcined, or deprived of its ſulphur, is eaſily ſaturated again therewith, from the oily part of any inflammable matter whatſoever; it likewiſe appears that the metallic earth, which is the baſis of tin, is a cryſtalline earth, very difficult to be melted; ſince common fire cannot vitrify this metal by itſelf, and that the heat of the ſun, collected in the *Focus* of this large burning glaſs, cannot perfectly melt the *Calx*, into which this metal

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metal is reduced; we may ſuppoſe, that the cryſtallization, or reducing of this metal into ſharp pointed particles, proceeds from the ſun's gradually breaking, and melting together into a ſolder, as it were, ſome of theſe ſmall cryſtals, as the ſulphureous parts evaporate, it not being ſtrong enough to melt them all down together in one entire maſs.

M. *Geoffroy* took lead, and holding it in fuſion upon charcoal, in the *Focus* of the glaſs, it waſted all away in fume; he expoſed the like quantity of lead on a ſtone to the *Focus*, where it emitted great quantities of fumes, and gradually changed into a fluid liquor, like oil, or melted roſin; this liquor, as it grew cold, fixed into glaſs, which has this peculiar to itſelf, that it is diſpoſed into plates, like *Venetian* talc, and that it is flabby, and ſoft to the touch, and tranſparent, and in ſome parts of a greeniſh, or reddiſh yellow; in continuing this matter in the *Focus*, it ſpread upon the ſtone, like varniſh, and at laſt penetrating it, it helped to melt it: He placed this talky earth in the *Focus* on charcoal, it melted, and in a little time after, re-aſſumed the form of melted lead; he withdrew it from the *Focus*, and letting it cool, he found it no ways different from lead: Theſe experiments ſhew, that there is in lead, as well as in the other imperfect metals, a ſulphureous part, that is eaſily ſeparated by common fire, or the heat of the ſun, and that this metal has for its baſis a foliated, or talky earth.

M. *Geoffroy* placed quickſilver in the *Focus* upon charcoal on the coppel, and on the ſtone, which was all immediately diſſipated, and exhaled in a very thick fume: He expoſed on the ſtone to the *Focus*, ſome *Præcipitat. per ſe*, in a degree of heat, equal to that of digeſtion, it ſeemed to melt, but it preſently evaporated, only there remained a ſmall quantity of a very rarified duſt, like a froth or ſcum; but continuing it in the *Focus*, it melted, and became a yellowiſh glaſs, wherein one might diſtinguiſh ſome particles of metal, like ſilver: He expoſed on charcoal ſome *Præcipitat. per ſe*, it fumed very much, and as it melted, one might obſerve little globules of mercury unite, and form themſelves together upon the coal, but they preſently evaporated: Theſe experiments ſeem to prove, that there is in mercury a ſulphur that may be ſeparated by a very gentle heat, ſuch as that of digeſtion; that as ſoon as mercury is deprived of this ſulphur, it loſes its fluidity, and brightneſs; that the baſis of mercury is a *Calx*, or red earth; that this *Calx* does not melt into glaſs, as the *Calx* of other metals, becauſe it is too volatile, evaporating by the heat as ſoon as melted; that on reſtoring a

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ſulphur to this *Calx*, by expoſing it again upon charcoal to the *Focus*, it immediately re-aſſumes its metallic brightneſs, and fluidity, and becomes mercury: M. *Geoffroy* could not determine, whether this light earth that remained on the ſtone, after the evaporation of the *Calx* of the mercury, were a part of the earth of the mercury, more exactly deprived of its oil, and conſequently more fixed, and proper for vitrification, or whether it might not be ſome matter foreign to the mercury, that fixes itſelf, and remains behind on its evaporation: The reſult of all theſe experiments, is, that theſe four metals, called imperfect, *viz.* iron, copper, tin, and lead, are compoſed of a ſulphur, or oily ſubſtance, and of a metallic earth capable of vitrification; that from this ſulphur proceeds the opacity, brightneſs, or malleability of a metal; that this metallic ſulphur does not at all appear different from the oil either of vegetables, or animals; that it is the ſame in mercury, as in the four imperfect metals; that theſe four metals have for their baſis an earth, ſuſceptible of vitrification; that this earth is different in every one of theſe four metals, in that it vitrifies differently in each of them, and that on this difference in vitrifying depends the difference of metals.

Obſervations on Inciſions of the Cornea; *by Dr.* Gandolphe. Phil. Tranſ. N° 322. p. 387.

CONTUSIONS on the bodies of animals do not always make the greateſt impreſſion on the parts, that immediately receive them; an inſtance of which Dr. *Gandolphe* had in a blow on the eye; there was a ſlight contuſion on the outſide of the part, with very little alteration to appearance; but a veſſel being broken within, poured fourth a conſiderable quantity of blood; the eye likewiſe loſt its tranſparency, and almoſt its ſight, which was ſo very weak, that it could ſcarcely perceive the greateſt light, when expoſed thereto; the *Cornea* appeared all over red, but without any inflammation, receiving its colour from the blood poured in upon the aqueous humour: The Dr. ſaw the patient the ſixth day after he received the hurt; he had been let blood thrice, and the eighth day the Dr. cauſed the *Cornea* to be opened near the middle, and intending to make a large orifice, he determined not to make it at the bottom of the *Cornea*; upon making the orifice, there iſſued forth ſome drops of the aqueous humour, mixed with blood; the *Cornea* ſtill appeared as red as before, and protuberant; this circumſtance made him reſolve immediately, to make a ſecond orifice, as large as the

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the former, but lower; and there run out some drops of the humour, and the eye did not appear so red, and convex, as before; the humour continued issuing from the orifice for some time; there was nothing applied to the eye, but a compress, or stupe, dipped in a mixture of four ounces of plantain water, and two ounces of a vulnerary water: The day after the operation, the upper part of the *Cornea* was transparent, the lower part not so red, and the whole membrane appeared to have recovered its natural convexity; it seems, that all the extravasated blood would have quite run out, had the lower part of the *Cornea* been opened, and remained so for some time; the Dr. observed the alterations of the eye for three days together, in which time the extravasated blood seemed sometimes to spread over the whole cavity of the *Cornea*; the Dr. judged, that the motion the patient himself might have used, had opened a-new some blood-vessel, or had mixed the extravasated blood, with the aqueous humour; for he did not perceive all that time, that there was any fresh effusion of blood: The fifth day after the two first incisions, the Dr. caused a third to be made, at the bottom of the *Cornea*; some drops of the humour issued out, and continued so to do, for some time, and in two days after the eye recovered its natural transparency: The pupil was now very much dilated; but again it gradually contracted, tho' not to its usual smallness; the *Iris* kept its motion all this while, so that he could not suspect that the lancet, in making the incision on the *Cornea*, any ways touched upon the *Iris*, because the pupil continued exactly round; and a blow, that can divide the continuity of the parts of the eye, and cause a suffusion of blood, is but too capable of depriving the *Iris* of its natural power of contracting: The pupil, which before the blow was one line in diameter, when the *Iris* was contracted, was then at least two lines in diameter; the transparency of the humours, and convexity of the *Cornea*, were the same as before; the sight was then restored, and there remained no other alteration, than what necessarily follows from the like dilatation of the pupil.

From hence may be drawn some remarks that may be of use in practice, and that incisions may be made successfully on the *Cornea*: 1. Incisions are made on this part, without any pain. 2. The orifices unite again without any scar. 3. We find, that plants of a discussive quality have a bad effect, the patient finding himself much worse, after using a cataplasm made of chervil and parsley; these plants, which are excellent in discussing extravased blood in the muscular parts, have

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have a bad effect, when applied to the eye, by causing pain, and rendering the sight more disturbed: When there is a considerable effusion of blood in the eye, in couching a cataract, and no orifice made in the *Cornea* to let it out, it may so alter the transparency of the vitreous humour, as to cause a loss of sight, which sometimes ensues upon this operation: The Dr. thought proper to make the incision near the middle of the *Cornea*, that the point of the lancet might not touch upon the *Iris*, which would have been of much worse consequence than a scar: The effusion of blood, that sometimes happens in couching cataracts, is discussed again, either by external applications, or by the help of nature; but when the effusion is very considerable; this operation may be necessary to prevent worse consequences: As for the scar, that sometimes ensues from an incision of the *Cornea*, the Dr. had read in an ancient author, that we need not apprehend it; but, if we make incisions on eyes, affected with inflammations, ulcers, or defluxions, which very much dilate the *Retina*, and vessels, an escar forms itself much more easily in these cases, and consequently we ought to use the greater caution.

An Experiment, shewing that an Object may become visible, in the dark, thro' such an opaque Body, as Pitch, *while under the Circumstances of Attrition and a* Vacuum; *by Mr.* Francis Hauksbee. Phil. Trans. N° 322. p. 391.

MR. *Hauksbee* melted some pitch in a globe glass, and kept it turning about, till the larger part thereof had got a pretty thick lining, that no ray of light could any ways penetrate it; he exhausted this globe of its contents of air, and it being night, he put it on the engine to give it motion; where after it had been turned a little while, with his hand on that part lined with the pitch, he could very easily discover, thro' the transparent part, on the inner surface of the pitch, the very shape and lines of his hand, as likewise those of his fingers, for the most eminent parts of the hand and fingers, that touched the glass, appeared all luminous; the other parts discovered themselves, by the dark intervals they made between the enlightened parts, and it appear'd plainly, when the fingers were either spread, or close together: Now, after a small quantity of air was admitted, the light disappeared on the inside of the lined part (but not on the other) which began to discover itself more and more on the outside, tho' even *in Vacuo* always a light attended on the touch of those parts, that were most contiguous to the glass; but now, a circle of light would discover itself, just on the edge of the pitch, which separated

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rated it from the transparent part, as likewise another ring of light, somewhat nearer the axis of the glass, but both these appeared, when the hand was applied to the under part; for when it was removed to the contrary part, no such appearance ensued; the transparent half of the glass was in all circumstances as in former experiments; when all the air was admitted, the electricity of the glass in all its parts, the lined as well as transparent, performed much alike, the threads seeming to be attracted every where with equal vigour: To conclude, this, and a former experiment of the sealing wax, plainly discover a transparent quality in some bodies, called opaque, under particular circumstances; it was never so much as suspected, that they could exchange that quality for the contrary one, and again resume their former state: What is said towards a reason of such an appearance in the experiment of the sealing-wax, *Phil. Transf.* N° 315. Mr. *Hauksbee* takes to be very applicable to this. Vide *Physico-mechanical Experiments on various Subjects.* p. 131.

An Account of some ancient Brass Instruments *found in* Yorkshire; *by Mr.* Ralph Thoresby; *with a Dissertation thereon; by Mr.* Thomas Hearne. Phil. Transf. N° 322. p. 393.

AS the servants of Mr. *Ellis*, of *Kiddal*, were plowing in a place called *Osmond-thick*, near *Bramham-moor*, they discovered five or six brass instruments, of different sizes, from little more than three to four inches and a half in length, and from one and a half, to two inches and a half in breadth; they were somewhat in the shape of a wedge, as proceeding from a thin edge, which after so many ages, was tolerably sharp, to an inch and a half, or two inches at the thicker extremity, where they were wrought hollow to put upon a shaft; each of them had an ear or loop: Some suppose them to have been arrow-heads, or axes of the ancient *Britons*; others, those of the Roman *Catapultæ*; but Mr. *Thoresby* rather takes them to have been the heads of spears or walking-staves of the civilized *Britons*; and tho' they were of a somewhat different shape from those described by *Speed* lib. 1. cap. vii. *Hist. of Great Britain*, whose figures Mr. *Thoresby* supposes, were taken from ancient MSS; yet by the loop in the side we may better conceive, how those ornamental labels were fastened, than by the figures there represented: That swords, or daggers were used in old times, of the same metal, as well in *Ireland* as in *Great Britain* (of which there are several described in the last edition of the *Britannia*) Mr. *Thoresby* conjectures from some that were found there of late years, one of which was of

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of a middle size, *viz.* 18 inches long in the blade; whereas, of those found in *Wales*, some were but 12, others 24 inches long; the hilt or handle, was probably of wood (as was that of an old sword Mr. *Thoresby* had, which was five foot and a half long) it having been entirely consumed; they were fastened together by four larger, or two smaller nails, as appeared by the holes in the brass, which were still entire: Mr. *Thoresby* had likewise an ancient spur, that was no less than six inches and a half long, from the heel to the middle of the rowel; but this which is gilded, and of a nicer workmanship, he supposes to be of a much later date.

From the great variety of ancient monuments, continually found in these islands, it is plain, that vast improvements might be made to the accounts that have been hitherto given of the *British* antiquities; divers places, that were of note in the times of the *Romans*, but now quite destroyed, have been since found out by means of coins, and the antiquity of some other towns may, by these helps, be carried much higher than Mr. *Cambden* has done; and particularly, *Witney*, within seven miles of *Oxford*, appears to have been a place of note, long before *Edward the Confessor*'s time, as Mr. *Hearne* gathers from *Roman* coins found there, the best of which, was one of impure silver, according to the custom of that time, in honour of *Julia Mammæa*, mother of *Alexander Severus*; and what makes it the more likely, that there was a town here so early, is, that the *Ickenild* road passed not far from it on the right hand, in its course to *Cirencester* where all the four great roads crossed.

From Mr. *Thoresby*'s relation of the instruments of brass, it is plain, that they are exactly like that in the repository, adjoining to the *Bodleian* library at *Oxford*; this has been kept there for several years, but where it was discovered, there is not the least memorial left to inform us; perhaps, it might be procured by Dr. *Plot*, when he was writing *The natural History of Staffordshire*, where cap. x. sect. 19. *&c.* he has mentioned several instruments of the same kind, dug up in that county: The figures of the tops of the spears of the ancient *Britons*, both before and after they were civilized, represented by *Speed*, *in loc. supra citat.* are altogether different from those we are now considering, being exactly of the same make with the figures we find in the *Columna Trajana*, and the books that represent the military instruments of the old *Romans*, and *Greeks*, &c. But had they been of some resemblance, yet Mr. *Hearne* cannot see, that those figures in *Speed* are of any authenticity; for tho' Mr. *Thoresby* con-

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conjectures, that they were copied from old MSS. yet Mr. *Hearne* could never meet with any MSS. of our *British* history, that had any such figures; hence, Mr. *Hearne* is inclined to think, that these figures are modern, and owing to Mr. *Speed* himself, and it is what he himself insinuates in the same chapter, acknowledging, that they were adapted to the descriptions given of the *Britons* in ancient authentic authors: But not to examine other particulars, the shape of the spears in their hands is not countenanced by any authority of note; for tho' *Herodian* has acquainted us, that they used short spears, yet, he is silent as to their make; nor indeed, have we any where a good account of the military arms of the *Britons*: Their authors are modern in comparison of the *Roman* authors, and withal romantic, and not to be relied on; and as for the *Bards*, they took no care to transmit to posterity these weapons, or give us exact relations of their countrymen: It is true, that there have been, and still are found several instruments made of flint, which the best judges esteem to be *British*; the flint heads of their arrows, are commonly called in *Scotland*, *Elf-arrows*, as being supposed to have an extraordinary virtue against the elves, and to drop from the clouds: There are other flints, somewhat resembling axes, and these Dr. *Plot* calls *in loc. supra citat. British* axes; but Dr. *Leigh*, in his *Natural Hist.* of *Lancashire*, lib. 1. p. 181. thinks they are *Indian*; Sir *William Dugdale* inclines to Dr. *Plot*'s opinion, and he acquaints us, in his *Antiquities of Warwickshire*, p. 778, with several of about four inches and a half in length, curiously wrought by grinding; but they might as well have been *Roman*, the *Romans* having used flint weapons, as well as the *Britons*, and it was from the *Romans*, that the *Britons* learned the art of working them; what seems to convince us, that they might be *Roman*, is, that those mentioned by Sir *William*, were found at *Oldbury*, *Aldbury*, or *Ealdbury*, which was a *Roman* fort, and signifies the same with *Alcheſter* in *Oxfordshire*, *Alcheſter* being nothing else but Ealb-ceaſtep so called by the *Saxons*, to shew that it was a place of antiquity, even in their time; and tho' the anonymous author of the antiquities of *Alcheſter*, at the end of the parochial antiquities of *Ambroſden*, derive it from *Allectus*, as if he were the founder; yet there is no authority, either from coins, inscriptions, or books, to countenance that conjecture.

Now, since there are no authentic authors, to inform us of the arms used by the *Britons* in their wars, Mr. *Hearne* can think of no method more proper for finding this out, than by examining what arms were in use among those people, from whom they im-

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mediately had their original: Mr. *Sheringham* inclines in h book *De Orig. Gentis Anglor.* p. 7. ſeq. to the ſtory of *Geoffrey* of *Monmouth*, who derives the *Britons* from the *Trojans*; and this is likewiſe the opinion of ſeveral learned men; but Mr. *Hearne* rather ſtrikes in with thoſe other writers of more authority, who derive the *Britons* from the *Gauls*, amongſt whom Mr. *Cambden* is the principal, who has diligently and nicely proved, that the *Gauls* and *Britons* had the ſame religion; that they both had their *Bards* and *Druids*, the ſame form of government, uſed the ſame method of fighting, had the ſame natural genius, were equally candid, and innocent, addicted to change when provoked, compaſſionate to their relations, and always ready to engage in their vindication; he has withal ſhewn, that they both affected great numbers of ſervants, that their buildings were alike, and ſurrounded with woods; that they both uſually wore chains of gold about their necks, and had rings on their middle fingers; that both wore long hair, and that the garments called *Brachæ*, were common to each: Theſe things Mr. *Cambden* confirms from the beſt and moſt approved authors; and as the chiefeſt argument, he has alledged variety of inſtances to ſhew, that they ſpoke the ſame language: Mr *Sheringham* was aware of this, and therefore to evade the force of the argument, he makes the *Trojans* to come thro' *Gaul*, which being then thinly inhabited, *Brute* and his aſſociates ſoon conquered, built a city, and continued there, till they had peopled it well; after which they paſſed over into *Britain*, and by that means the *Britons* came to have the ſame language: But this does not ſeem conſiſtent with the uſual prudence, nor with the other wiſe acts aſcribed to *Brute*; for it is not probable that *Brute* would voluntarily leave ſo large a country as *Gaul*, for one that was ſo much ſmaller; it is therefore more likely, that the *Britons* had their immediate original from the *Gauls*; *Cæſar* himſelf thought ſo, as to thoſe that inhabited nearer the coaſts, notwithſtanding his obſervation, that the midland people were *Aborigines*: Nor will *Boxhorn*'s aſſertion, that the *Gallic* tongue was the ſame with the *Scythian*, overthrow this hypotheſis; for it may very well be ſuppoſed, that the *Gauls* came firſt from the *Scythians*, who are in *Juſtin's Hiſt.* lib. II. cap. 1. obſerved to have been the moſt ancient people, and to have contended with the *Ægyptians* on that ſcore; this will exactly agree with what *Cambden* and others have aſſerted, concerning the *Gauls* being deſcended from *Gomer*, the eldeſt ſon of *Japhet*; Mr. *Sammes* it is true, derives the *Scythians* from *Magog* the ſecond ſon of *Japhet*; but (not to take notice here of his contradicting himſelf in this point)

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point) since *Strabo* lib. II. and *Stephanus de Urbib.* voc. γωγαρηνη, mention a city called *Gogarena*, between *Colchis* and *Iberia*, and since the city *Hierapolis*, in *Cœlo-Syria*, according to *Pliny Nat. Hist.* lib. V. cap. 23, was called by the *Syrians*, *Magog*, it is more probable, that *Magog* seated himself in those countries, near which it is agreed, his brethren settled, than that he wandered so far from them: Here Mr. *Hearne* observes, that the *Britons* were, like the *Scythians*, a frugal people, and their longævity (they often living to the age of 120 years) might in a great measure be ascribed to their temperance, and their milk-diet (just like the *Hippomolgs* mentioned by *Homer*, il. xiii. v. 3.) and as *Æschylus* tells us, that the *Scythians* were ιππικῶς Βοτῆρες συννομοι, i. e. *a nation addicted to the feeding of horses*; so the same may be said of our ancient *Britons*, who were very religious, and observed the rules of their priests, and took extraordinary delight in cattle; whence, perhaps, they might affect to have the figures of beasts cut upon their bodies.

The next enquiry is, what arms were used by the *Gauls?* There are several authors, that have written of their nature, particularly *Culverius* and *Boxhorn*; the names of these arms are *Spatha*, *gessum*, (*gesum* or *gæsum*) *lancea*, *sparum*, *cateia*, *mataris*, or rather *materis* not *matara*, *machæra*, μαρις, μαῖρις, μάρις, or μάαρις, *thyreos*. Vide *Liv.* lib. viii. cap. 24. edit. *Oxon.* and *cetrum* or *cetra*: Mr. *Hearne* observes in general, that the *Gessum* was a javelin, the *sparum*, *mateia*, & *mataris*, different sorts of darts, and that the *Thyreos* was an oblong, and the *Cetrum* a short kind of shield; so that the *Spatha* only remains (for the nature of the lance is well known) to be compared with the weapons we are considering; it is called by the *Italians*, *Spada*, and by the *Spaniards*, *Espada*; from the description *Isidore* has left us of it, we are informed, that it was a two edged sword, with which they cut and not thrust; whence it is plain, that these arms had not sharp points, agreeable to what *Livy* lib. xxii. cap. 46. edit. *Oxon.* has related, *viz.* that their *Gladii* were *Prælongi, ac sine mucronibus*; and *Polybius* has the same reason, why they did not push with them; hence it is plain, that our instruments, which have not two edges, but are dull like wedges, were not *Spathæ*, and since they do not agree to any of the other *Gallic* weapons, we may carry on our enquiry, and examine, whether they agree with any of the arms of some other nation, that made a figure in *Britain*.

Our ancestors the *Saxons* can have no share in this inquiry; for it is plain from their history, given by *Verstegan*, and likewise

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from the figures publiſhed by him, that ſpears, halberts, ſhields, croſs-bows, ſwords (which were broad and bent ſomething reſembling a ſcythe) and hatchets, which they called bills, were the arms made uſe of by them; nor did the weapons of the *Danes*, that ſucceeded them, vary much, if at all; for coming from the ſame parts, they uſed the ſame cuſtoms in their military exploits: But tho' theſe weapons do not reſemble either the *Saxon* or *Daniſh* military arms, yet Mr. *Hearne* finds in *Wormius*'s *Muſæum*. p. 354. two *Cimbric* inſtruments, with which they have ſome reſemblance; theſe he tells us were of braſs, and he calls them wedges; the larger ſort of them were five inches long, and three inches broad; he is of opinion, that they were uſed in war, eſpecially, when the armies were very near each other; if they had had holes, by which they might have been fixed to helves, he would have believed them to be battle-axes; but being neither hollow, as ours are, nor having any other way of being faſtened to other inſtruments, he concluded, that the name of wedges might be moſt proper: A certain gentleman informed Mr. *Hearne*, that much the ſame inſtruments had been found in the *Iſle of Man*, and that a great many urns had been likewiſe diſcovered there, as alſo divers inſcriptions, with odd characters; Mr. *Hearne* does not queſtion, but the inſcriptions were *Runic*, and it is highly probable, that the inſtruments were like thoſe in *Wormius*; but if they agree exactly with ours, they will appear to be *Roman*: For tho' it be commonly held, that the *Romans* never were in the *Iſle of Man*, yet he ſees no other reaſon, why it ſhould be thought ſo, than that ancient authors make no mention thereof; this is only a negative argument, and what we ought not to lay much ſtreſs on; the urns ſeem plainly to evince, that they were there; it is ſaid indeed that theſe urns muſt be *Daniſh*, becauſe of the ſmall black bones and aſhes found therein, which however, is no ſure ground to go upon; for Mr. *Hearne* has ſeen in the *Bodleian* repoſitory, a piece of a *Roman* urn, dug up ſeveral years before at an old *Roman* town in *England*, with ſeveral others, ſome of which were of different figures; and with it were found little black bones, aſhes, *&c.* wrapped up in two pieces of coarſe linen, of the ſame figure with the urn; the ſmallneſs of the bones ſhews, that they were the relicks of children; it was cuſtomary amongſt the *Romans* after the bodies were burnt, to waſh the bones with wine, and milk, and afterwards the women wrapped their children in linen, dried them in their boſoms, and then put them into urns to be buried; this cuſtom was alſo peculiar to the *Danes*, who learned it from the *Romans*, from whom likewiſe they received

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urn-burial itself; such urns are likewise mentioned by Sir *Thomas Brown*, to have been found at *Old Walsingham*, in *Yorkshire*; nor is the *Roman* history altogether silent as to the *Isle of Man* being known to the *Romans*; for *Plutarch* expressly tells us, that one *Demetrius* sailed thither, as well as to the other *British* isles, in the reign of *Adrian*; it is not surprising, that *Runic* inscriptions are discovered in the places where *Roman* urns are found; those inscriptions might have been made upon other occasions, after it became inhabited in future ages by *Danes* and *Norwegians*; the same thing has sometimes happened in *England*; and Mr. *Cambden* particularly relates, in the close of his discourse concerning *Stone-henge*, that in the time of King *Henry* the VIII. there was found at *Stone-henge*, a table of mixed metal, on which were engraved several letters, but the character was so odd, that neither Sir *Thomas Eliot* nor Mr. *Lilly*, the famous school-master of St. *Paul's*, could tell what to make of them, so there was no care taken to preserve the monument, which *Olaus Wormius* took to be *Runic*, as undoubtedly it was; and yet *Stone-henge* itself is a *Roman* work, as has been made out by Mr. *Inigo Jones*, who tho' he was answered by the learned Dr. *Charleton*, yet Mr. *Jones's* opinion was very well defended by Mr. *John Web*, who in his book has distinctly examined the methods made use of both by the *Romans* and *Danes* in their buildings.

Mr. *Hearne* having shewn that these instruments were not military arms, either of the *Britons*, *Saxons*, or *Danes*, carries on his enquiry farther, and endeavours to prove, that they were *Roman*; he once took them to be a sort of axes, which the *Romans* made use of in their sacrifices, and Dr. *Plot* takes notice of two sorts of them, the *secures lapideæ*, and the *secures cupreæ*, tho' Dr. *Leigh* will have both his instances to be *Indian*.

Upon a more narrow consideration of the *Roman* sacrificing instruments, Mr. *Hearne* quite changed his opinion, not finding the least foot-steps of such axes in any of the books of *Roman* antiquities he hitherto consulted; on the contrary they are in the *Souvetaurilia*, or *Solitaurilia* of the *Columna Trajana*, represented in the same form, and fastened in the same manner, as we use at this day; and so also in other sacrifices, as may partly be seen in the gems, rings, &c. published out of the studies of *Augustinus* and *Gorlæus*, as well as in the monuments of *Gruter*, *Reinesius*, *Spon* and *Fabretti*, not to mention the authors on this subject collected by *Grævius* in his book of *Roman* antiquities; neither could they have been the heads of spears, as is manifest from the same authorities; the *Roman* spears and javelins occur very frequently, and

yet

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yet not one of them, either on their coins or elſewhere, is to be met with in the ſhape of theſe inſtruments; it is true ſome of their ſpears had two heads, ſo that they might uſe either end uppermoſt, as they pleaſed: We have one of theſe in *Auguſtinus Gemm. & Sculpt. Antiq. ex Edit.* Jac. Gronovij Franc. 1694. *Part. num.* 155; the heads differ from each other, but neither of them anſwer our monuments; nor are the moſt ancient ſpears of the *Romans* we meet with, different from thoſe they made uſe of in more modern times, as may be ſeen in ſome meaſure, in the famous ſhield publiſhed at *Oxford, Liv. Edit.* Oxon. Vol. VI. p. 195, which is certainly authentic; it may here be farther added to what is there alledged, that *Florus Lib.* I. *Cap.* 9. gives us the firſt inſtance of the *Romans* fighting on horſes, without bridles; and in the *Columna Trajana Num.* 199. the horſes are repreſented in full ſpeed, with their riders without any bridles, or other curbs to reſtrain, or guide them; a great many of the *Romans* having made themſelves maſters of this method of fighting, that they might like the *Numidians* (who were famous for it) be the leſs incumbered in battle, and ruſh upon the enemy with the greater fury; their *Deſultores* are likewiſe ſufficient proof of its being practicable: But now tho' theſe inſtruments are not properly *Roman* military weapons, ſuch as they uſed in their battles; yet, they were of ſervice amongſt their ſoldiers, and good numbers of them were conſtantly provided to be carried about in the army; for Mr. *Hearne* takes them to be *Roman* chiſels, and that they were made uſe of to cut ſtones, and other materials, that were judged ſerviceable for building their camps; this is not a bare conjecture, as appears from the *Columna Trajana*, where in *Num.* 167, the ſoldiers are repreſented, poliſhing the ſtones for the *Roman* tents, in the *Dacic* wars, with ſuch ſort of chiſels made of braſs, which they beat and work into the ſtone, and other materials, with mallets of the ſame metal: There are other inſtances of it in the ſame pillar, which is one of the beſt monuments we have, whereby to judge of the ſeveral inſtruments made uſe of by the *Romans*, in their military enterprizes; theſe chiſels were of admirable ſervice in making their *Aggeres*, which conſiſted of earth, ſtones and timber; the ſtones were ſometimes thrown together, without any poliſhing; but that was more rarely, and it was looked upon as a better ſecurity, to have them worked, that they might lie even; by this account, the reaſon will eaſily be perceived, why theſe inſtruments are hollow, namely, to faſten handles to them, for the greater conveniency in driving them; if they

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they had been wedges, it would have been a great inconveniency to have had them hollow; beſides the wedges, by being drove into the wood, or ſtones, would have been ſtrangely worn on the ſides, and have received conſiderable alterations; whereas, the ſides of thoſe in the *Bodleian* repoſitory are juſt as they were at firſt, and there is not the leaſt change, unleſs it be on the edge, which is very blunt, and much broken, which he conjectures to have been occaſioned by the ſtone; as for the ears, or loops, it is probable, they might be put on, that thereby the handles might be the better fixed; or perhaps, they were deſigned for the eaſe of the ſoldiers, who in their journeys, might by this means faſten them to their girdles; for Mr. *Hearne* believes, that moſt, if not all the ſoldiers had ſuch inſtruments, which they were obliged to make uſe of, when neceſſity required: It is the opinion of moſt, that there were a few particular perſons always in the army, to whom theſe works were committed, and that they were exempt from the duty of ſoldiers, and were *Marmorarii*, *Quadratarii*, *Tignarii*, & *Structores*; and theſe may be called all by one name *Fabri murarii*, tho' that is commonly reckoned, only another name for *Structores*; but this is a wrong opinion, and *Fabretti in Syntag. de Columnâ Trajanâ p.* 208. has well obſerved, that there are no *Fabri murarii*, as they are taken for artiſts, diſtinct from ſoldiers, on *Trajan*'s pillar; this obſervation he has made in oppoſition to *Santi Bartoli*, who expreſsly calls them *Fabri murarii*: *Fabretti*'s remark, as it is very juſt, with reſpect to this ſort of artiſts, ſo it muſt be noted, that there were no other diſtinct artiſts, that were exempted from the duty of ſoldiers; even the artiſts, that had received liberal education, namely their phyſicians are to be comprehended in this obſervation; which is the reaſon, that in *Fabretti loc. citat. p.* 217. we have the picture of a phyſician, armed with a *Lorica*, or coat of mail, and ſtretching his hands to a ſick perſon, that was his patient; the *Lorica* ſhews he was one of the better ſort of ſoldiers, called *Evocati*, thoſe of the inferior order being allowed, only a breaſt-plate of thin braſs; and withal it ſhews, that after he had performed theſe offices to the ſick, he was obliged to betake himſelf to the other offices of a ſoldier; this was ſometimes intermitted; but in *Trajan*'s ſtrict diſcipline, it was always obſerved, he being reſolved to imitate, and bring into faſhion the ſeverity that had been made uſe of, in the more ancient times; for this reaſon, we ſee the ſoldiers repreſented in this pillar, duly exerciſing, when there was any occaſion, all the offices

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offices of tradesmen, it being customary at this time, to list tradesmen amongst the soldiers, for this intent.

Besides the uses these instruments were put to in forming the *Roman* camps, they were moreover, employed in making and repairing the high-ways, which swallowed up a large quantity of stone, especially in such places as were marshy, and fenny; the *Pomptin-marshes* were vastly large, and yet at such time, as the soldiers were too numerous to be employed against the enemy, a motion was made, that they should be employed to drain them, which was so well approved of, that the senate immediately gave orders for it, and the soil was so rich, and fertile, that great numbers came and settled there, insomuch, that there were no less than 33 towns built upon the ground; the waters, however, afterwards got strength again, and it was in a manner, wholly drowned, which made *Julius Cæsar* entertain some thoughts of draining them a-new, and of carrying the *Appian* way through them, whereas, before it went about them; but he failed in his design, and it was left for the emperor *Trajan*, who, after he had cleansed the fens, caused a stone-way to be made thro' them, whereon were built large inns, and magnificent bridges, for the conveyance of the water, that was in the upper part of the marsh; in memory of which, he had a monumental stone erected, with a proper inscription, by which it appears, that the way was 19 miles in length, there being placed at the end of every mile, a mile-stone, and from thence the way itself was in succeeding times, called *Decennovium*; and as *Trajan* was diligent about the roads in *Italy*, and other parts, so it seems that he was no less solicitous about them in *Britain*; for notwithstanding some people would persuade us that the four great roads in *Britain* are owing to *Molmutius*, one of the *British* kings, and *Belinus* his son; yet Mr. *Cambden*, and others have shewn, that they are rather to be attributed to the *Romans*, being repaired, and made a-new; as it were (whereas before they were very mean) by *Trajan*, after he had reduced the *Britons* to obedience; besides which roads, he likewise made divers other lesser ones here; and perhaps these chisels may be some of those, used by the soldiers in his reign, tho' before his time acts of this kind had been performed by the *Roman* soldiers, who also obliged the *Britons* to undergo the same drudgery, which made them complain to *Agricola*, as if they were too severely and hardly dealt by.

If it be asked, how these instruments come to be of brass, rather than of any other metal? It may be replied, that they, as well

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well as the people of other nations, in former times, thought there was an extraordinary virtue in braſs; whence it was, that they uſed braſs inſtruments, when the moon was in an eclipſe; *Liv. Lib.* XXVI. *Cap.* 5. *Edit.* Oxon. imagining, that by beating of them, ſhe would be recovered the more eaſily from her labour, which cuſtom almoſt univerſally prevailed; and it was on account of this peculiar virtue, ſuppoſed to be in braſs, that the inſtruments, made uſe of in the ſacred offices were in the more early times, all of braſs; that the *Tuſcans* uſed braſs plough-ſhares, when their cities were built, and that the prieſts of the *Sabines* were ſhaved with braſs razors, *Rhodigini Antiq. Lect. Lib.* XIX. *Cap.* 10. *Heſiod* himſelf tells us Ἔργ. καὶ Ἡμ. *Lib.* I. v. 150. that the ancients uſed braſs inſtruments, before iron ones.

Χαλκῳ δ' ἐργάζοντο μελάϛ δ' οὐκ ἔϛκε σίδηρος

At which time, not only their arms, but their houſes were likewiſe of braſs *ibid.* v. 149.

Τοῖϛ δ' ἦν χάλκεα μὲν τεύχεα, χάλκεοι δ' ἔϛαν οἶκοι

The cuſtom might prevail as well in *Britain* as elſewhere, iron not being ſo very plentiful in the firſt time of the *Romans*, however it might increaſe afterwards, when the bath-forge was erected, and all proper methods uſed upon that occaſion; nor ought it to be wondered at, how the braſs chiſels could be applied to the ſtone, without breaking immediately to pieces, any more than that the plough-ſhares did not ſuffer the ſame damage, in caſting up the ground, and grating againſt the ſtones, with more violence; the braſs in thoſe early times was of a different nature from ours, and tempered in ſuch a manner, as to laſt much longer without inconveniency, in the ſeveral operations, to which it was applied.

As to Mr. *Thoresby*'s *Daniſh* ſpur, there is one in the *Bodleian* repoſitory of much the ſame length, of which Mr. *Hearne* makes mention in *p.* 43. of his *Additions* to Sir *John Spelman*'s *Life of King Alfred*; and there have been ſeveral others found in *England*; and Mr. *Thoresby* has juſtly conjectured this to be more modern than the other inſtruments; for theſe ſpurs are certainly *Daniſh*, as appears from *Wormius*'s *Monumenta Danica* p. 50, where he has given us the figure of one; and there is an

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account of divers others, towards the latter end of his *Muſæum*, one of which is a foot, and ſome odd inches long.

An Account of a Bunch of Hair, *voided by* Urine; *by Mr.* James Yonge, *with Obſervations thereon, &c. by M.* Leewenhoeck. Phil. Tranſ. N° 323. p. 414.

A Plethoric woman about 50 years of age, and often afflicted with nephritic pains, appeared not only to have ſtones, and gravel, but by the purulency and ſtench of her urine, an ulcer in one, or both her kidneys; and therefore, Mr. *Yonge* gave her a doſe of *Cantharides*, with camphire, made into pills, and followed it with plentiful draughts of a ſlippery emulſion; this made her void by urine a deal of blackiſh gravel, and white thick matter, like bird-lime, without any pain, or bad ſymptoms, and ſhe continued eaſy for a week; then her pains returned, and went off by the ſame remedy; about 18 days after, her pains ſeeming to threaten a return, he repeated the medicine; but that night it gave her very great pain in the ſide of her belly, and at laſt threw her into convulſions, which went off upon a diſcharge of urine, and of a great deal of matter wherein was a bunch of ſhort hair almoſt rotten; for ſome time after, ſhe uſed a nephritic courſe, which preſerved her from the return of pain, matter, ſtones, and an obſtruction of urine.

M. *Leewenhoeck*, viewing thro' a microſcope part of the abovementioned hairy ſubſtance, ſuppoſed it to be the hair, or white wool of a ſheep, which was broken into ſuch ſmall, or ſhort particles, that ſome of them were no longer than ſix diameters of a ſingle hair, and which he ſuppoſes could not proceed from a man's body; but that it was rather found in the heel of one's ſtocking; and the oftner he repeated his obſervations, the more he was confirmed in his opinion; for he could not only diſcover the ſhort, broken, woolly particles, but he alſo ſaw a great many of their extremities ground to pieces, as it were; inſomuch, that not only the outſide of the woolly particles was rubbed off, but the internal little hairs, of which the wool conſiſts, were ſo divided from each other, that they appeared with their ends like little bruſhes: Moreover, under the ſaid white woolly parts, there lay very ſmall particles compoſed of exceeding ſlender ſmall tubes, which he ſuppoſed to be little bits of ſtraw, and they were ſo minute, that a ſingle grain of ſand would cover them all; there were likewiſe other ſmall particles of the ſame figure, which he did not take to be ſtraw, but rather the outer

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outer husk or rind of a grain of wheat, or rye; and under those he saw one particle, covered all over with small hairs, such as are seen at the top of wheat or rye; as also a few little bits of wood, somewhat thicker than the hair of one's head; there was likewise a small particle of a man's scarf-skin; for he could very plainly see the little scales of which that skin consists; now these particles, that were not wool, might very easily be brought into the stocking, in case a person puts the bare foot upon the floor, before he puts the stocking on: Moreover, there lay in the said matter a vast many exceeding slender long particles, which M. *Leewenhoeck* supposed to be those hairy particles, of which a small fibre of wool consists; as also several earthy particles, which he took to be part of the dirt of the floor, or of the foot itself: There also lay a great many peculiar small figures, but he could not discover what they were, and they adhered so firmly to some little hairs, or wool, by means of the viscous matter perspired from the foot, as he supposes, that he could not separate them, but with some water; amongst others, there also lay two slender particles, which he would have taken for the scarf-skin of a man, were it not that the scales were larger than any he could ever take from his own skin, which are mostly of an equal thickness: In short there appeared to his sight so many, and such particular figures, that he could not determine them; only he observed amongst them one small particle, not of a single feather, as it appears to the naked eye upon the body of a fowl, but rather of the finest down; and the more he unravelled, or separated the particles of wool from each other, he had still the greater reason to conclude, that the person who had worn the stocking, was wont to go often bare-footed on the floor: Now supposing, that these woolly particles had fallen into any spoon-meat thicker than ordinary, the person might swallow it down, without being aware of it; his reason for supposing, that these woolly particles came from a stocking, and these produced by the motion of the foot, is this; upon viewing several times the broken woollen particles of a stocking, which lie in a heap together under the heel; and having also singled out of them several fibres, or threads of wool, they consisted of small hairs, exactly agreeing with those in the above-mention'd lump of hair.

M. *Leewenhoeck* had the gut of an uncommon large, and fat cow, part of which he inflated, and but a little, least its membranes should be too much distended; and he imagined, that he observed one membrane, in which there lay abundance of small fibres lengthwise, and very regularly disposed by each other;

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and that in another membrane in the ſame place, there lay other fibres tranſverſely, running from the center to the circumference of the gut; from which obſervation he ſuppoſes, that that motion, we obſerve in the guts, as ſoon as they are extracted out of the cow, is the ſame by which nature is wont to protrude, and diſcharge the chyle out of thoſe parts: He alſo blew up the bladder of this cow to the bigneſs of two ordinary fiſts, to the end he might the better ſeparate, or diſtinguiſh its membranes, and ſo he let it dry; and cutting it thro' at about two fingers breadth from the neck, he judged (having placed a piece thereof before his microſcope) that there were 12 membranes lying one above the other, which was alſo confirmed by a perſon that ſtood by; M. *Leewenhoeck* likewiſe ſuppoſed, that ſome of thoſe membranes might be divided into other two, for the bladder to be diſtended into a larger ſpace.

An Account of ſeveral ſolid Bodies *voided by* Urine; *by Mr.* Yonge. Phil. Tranſ. N° 323. p. 420.

WE have many inſtances in authors of ſeveral uncommon things diſcharged by urine; and in particular *Diemerbroeck* in his *Anatom. lib.* I. *cap.* 17. from his own knowledge mentions divers inſtances to this purpoſe, and many more from *Plutarch*, *Langius*, *Alex. Benedictus*, *J. M. Heſſius*, *J. Alexandrinus*, *N. Florentinus*, *P. Pigræus*, and others; *viz.* that needles, lumps of fat, iron keys, roots, ſeeds, nails, *&c.* have come away by urine; to theſe may be added *Tho. Bartholinus*, in *Act. Medic. Vol.* 2. *Obſ.* 125. *Vol.* 3. *Obſ.* 68. *Vol.* 5. *Obſ.* 57, 70. As alſo in his *Tr. de Lact. Thorac. Cap.* 6, 9. *Fabricius Hildanus Cent.* 5. *Obſ.* 51. who write of pins, *&c.* diſcharged by urine; but Dr. *Fairfax* writes of a caſe ſtill more ſurpriſing, *viz.* a leaden-bullet ſwallowed by a woman for the cholic, and voided by urine ſome years after, incruſtated with a gravelly, gritty, and ſtony accretion, as mentioned in *Phil. Tranſ.* N° 40. Mr. *Yonge* was aſſured by a phyſician in the weſt part of *Cornwal*, that he knew a woman, who had voided by urine a ſmall plumb-ſtone; but there happened at *Loo* in the ſame county a more ſurpriſing accident of that ſort; *viz.* one *Nathaniel Mitchel*, about 50 years of age, was in the ſummer 1690 ſeiſed with violent cholic pains, which he mitigated by glyſters, but could not perfectly free himſelf from them; about *Michaelmaſs* 1691 his pains being very violent, he was relieved by the ſame medicine, and drinking the powder of nettle-roots in white wine; after the firſt or ſecond doſe he diſcharged a great quantity of urine, with a very

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a very feculent ſediment; about the beginning of *November*, being coſtive, he eat mallow-roots and currants boiled, and mixed with butter; his uſual laxative medicine; in a little time, after eating it, he was much diſordered, and complained of an oppreſſion by wind; at length the wind (as the patient termed it) ſettled at the bottom of his belly, and in a very little time he voided with his urine ſome of the herbs, with above 40 currants; a few days after he diſcharged the ſame way ſeveral parſley-leaves, which he had eat a little before; the phyſician being ſhewn the patients urine, he at firſt ſuppoſed that ſome of the *Faeces* had been evacuated that way, and that ſome latent ulcer had made a paſſage thro' the *Rectum* into the bladder; but he found it otherwiſe; for there was no *Faetor* in the patient's urine, he had no *Tenesmus*, no bloody, nor purulent dejections; but to ſatisfy himſelf farther in this particular, the phyſician ordered him a glyſter tinctured with indigo, which he retained above half an hour, but his urine was not at all diſcoloured with it; he preſcribed pills of --- two of which came away in his urine of an oblong form, about the bigneſs of the end of the firſt quill in a gooſe's wing; ſometime after the patient voided by urine a piece of a raiſin; he lived till *Midſummer* 1692, in which time he diſcharged the ſame way, at ſeveral times, parts of roots, and other things he eat.

Diemerbroeck, *Fairfax*, *T. Bartholine*, *O. Borichius*, *N. Blegny*, *M. Pecquet*, and others are of opinion, that there is a more latent paſſage for the urine to the emulgents, &c. than thoſe commonly ſuppoſed; and they think it appears ſo by divers *Phænomena*, and experiments they had made, and that their objections againſt the common opinion are inſuperable; it is certain, that the matter of an *Empyema*, has been voided by urine, and to that purpoſe diuretics are uſed in vulneraries, &c. Vide *Malpighius*, *N. Blegny*, Serjeant *Wiſeman*, &c. And Mr. *Yonge* has known a large, ripe apoſtumation in a woman's thigh, ſuddenly ſink, and all the matter come away by urine; Mr. *Leyſer* in his obſervations gives an account of a ſimilar caſe; Vide *Phil. Tranſ.* N° 50: Mr. *Yonge* had a boy brought him, of about ſix years of age, that voided the moſt part of his urine from an orifice in the navel; and *Blaſius* or *Veſlingius*, relates a ſimilar caſe, and accounts for it.

An

An Account of an unuſual Blackneſs *of the* Face, *and of ſeveral extra-uterine* Fœtus's, *&c. By the Same.* Phil. Tranſ. N° 323. p. 424.

THO' M. *Leewenhoeck*'s objections againſt the bunch of hair, voided by urine, ſeem to have ſome force, yet they did not at all affect Mr. *Yonge*'s belief of the truth of the fact; for, beſides a nice examination of all the circumſtances, he was perſuaded, that it came thro' the *Urethra*, and was neither conveyed nor dropped accidentally into the pot, by ſuch evidence *à poſteriori*, as is little ſhort of demonſtration; as that the patient felt it coming away, that the tumour on the ſide of her belly, where her chief pain lay before the evacuation, vaniſhed with it, together with all thoſe ſymptoms that affected her; ſuch as a ſtranguary, fetid, and purulent urine, and which did not return in two years after.

A girl of *Plymouth*, 16 years of age, had about the latter end of *April*, 1709, a few hot pimples riſe on her cheeks, which bleeding and a purge or two cured; ſhe continued very well till about a month after, when her face ſuddenly turned black, like that of a negroe; this ſurpriſing accident much frightned the girl, even to diſtraction; when Mr. *Yonge* was called to her, by the arguments he uſed, and ſome compoſing anti-hyſteric medicines, the violence of her fits was much abated; he alſo ordered a lotion for her face, which took off the diſcouloration, but it returned frequently, tho' not periodically, ſometimes twice or thrice in 24 hours, at other times five or ſix times; it came on inſenſibly without pain, ſickneſs or any ſymptoms of its approach, excepting a little warm flushing, juſt before it appeared; it came eaſily away, and left the ſkin clear and white, but ſmutted the cloth, that wiped it from the face; it felt unctuous and ſeemed like greaſe, and ſoot, or blacking mixed together; it had no manner of taſte, which was ſurpriſing that a ſuliginous exſudation ſhould be inſipid; ſhe never had the *Menſes*; was thin, but healthful; the blackneſs appeared no where, but in the prominent part of her face.

A clergyman communicated the following occurrence to Mr. *Yonge*; viz. A gentleman's ſervant having killed an ewe, that was thought fat, and taking out the bowels, he found a very unuſual and monſtrous lump of fat, proceeding like a wen from the middle of the *Omentum*; the clergyman, cutting it open, found

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found incloſed a lamb, of the ſame parts and dimenſions, with others of that kind: *Quere*, how it came there, and how nouriſhed? Mr. *Yonge* had been once ſhewn the like in a bitch, by a ſurgeon in *Oxford*, and having obſerved and conſidered all of that nature, which occurred to him either in books, or otherwiſe, concluded, that that lamb was not conceived in the womb, but in one of the *Tubæ Fallopianæ*, where growing too big to be contained, it either broke out into the place where it was found, or ſlipped back towards the upper orifice, and thro' it into the ewe's belly; that afterwards aſſiſted by the prone, and inclining poſture of the ſheep's body, it ſlipped forwards to the *Omentum*, and was nouriſhed there the uſual way; *viz.* by the *Placenta*, which was doubtleſs fixed in the *Tuba*, and the *Pedunculus* remaining entire, it will eaſily extend from thence to the *Fœtus*.

Riolanus the younger, *Anthropog. Nov.* lib. 2. cap. 34. was the firſt that publickly obſerved theſe ſtrange conceptions, and he tells us, they have the ſame coats, ſecundines, *&c.* as *Fœtus*'s in the womb; and conſidering the anatomical diſcoveries, and new hypotheſis of the genital parts in women, and their uſes in generation, made by *Theod. Kirkringius*, *Reg. de Graaf*, and others, it ſeems more than probable, that ſuch conceptions happen, when *in coitu* one of the *Ova* deſcends into the *Tuba*, and not being able to paſs into the *Uterus* thro' the lower orifice, (which is ſometimes, and in aged perſons always contracted) and being however impregnated by the *Aura ſeminalis* or *Animalcula*, with which the *Teſtes*, and ſeminal parts of ſome males do ſo prodigiouſly abound, that M. *Leewenhoeck* affirms, that the milt of a cod-fiſh has more *Animalcula*, than there are people on the earth, Dr. *Hook*'s *Phil. Collect.* N. 1. it grows till too big to be contained therein, and then breaks forth into the belly; tho' ſometimes they continue in the *Tuba* itſelf; there the *Placenta* fixes and draws nouriſhment, as from the *Fundus Uteri*, and if the *Pedunculus* hold firm, conveys it to the *Fœtus* in the ſame manner as it does to thoſe in the womb.

Such extra-uterine *Embrio*'s have been ſometimes found in women, but not publickly taken notice of, till the beginning of the laſt century, by *Riolanus* the younger, as above-mentioned, with this remark, *viz.* the *Tubæ Fallopianæ*, ſays he, *appear to be of the ſame nature and ſubſtance with the* Uterus, *becauſe they are fleſhy, and it was obſerved that a human* Fœtus *was conceived therein*; and then he gives an account of four ſuch ſtrange conceptions, which occurred to himſelf; a more ſurpriſing conception was afterwards found at *Paris*, *January* 1669, by

by *Vesalius* in the right *Tuba* of a woman; it was four months old, and grown so big, and the *Tuba* so distended, as to make him mistake it for another womb, and accordingly call the account he published thereof, *Demonstration d'une double Matrice*, Vide *Phil. Trans.* N° 40. *German Academ.* vol. 1. obs. 110; but neither seemed to understand the mystery, till *de Graaf* made use of this very observation to illustrate, and confirm the hypothesis of *Kirkringius*; and soon after, *Elsholtius*, a learned *German*, did the same in his tract, *De conceptione Tubaria, quâ humani Fœtus extra Uteri cavitatem in tubis quandoque concipiuntur*; he gives the figure of the two supposed wombs, and the *Fœtus* in the distended tube; and amongst other such conceptions, he mentions two large *Molæ* found without the *Matrix* of a woman.

About 10 years after, a much more astonishing instance happened at *Paris*, a woman A. D. 1652. came to her full time of bearing; but 'tho she had all the symptoms usual at that season, no child came; she continued in that condition 20 years, still feeling the child within her; from that time she felt no motion it had; in *June*, 1708, she died, and was opened next day; when there was found in her belly, without the womb, a dead child wrapt up in the *Omentum*; it weighed eight pounds; vide *Journal des Scavans*. A. D. 1678. *Phil. Trans.* N° 139. M. *Blegny*, in his *Zodiacus Medicus*, vol. 1. obs. 9.

In *Holland*, *December*, 1658, M. *Rhoonbuys*, met with such another instance; a woman with child, at her full time was four days in labour, and could not be delivered; M. *Rhoonbuys* being called, found the *internum Osculum Uteri* close shut up, without flooding, or other fore-runners of delivery; upon finding the common passage so closely shut up, and a very painful tumour above the navel, he proposed the *Cæsarean* section; but he delay'd it, till the woman was past recovery; upon opening the belly after her death, he found a child among the intestines, and the *Placenta* fastened to the *Colon*, and part of it to the *Fundus Uteri*, and that there was a breach in the womb large enough for the *Fœtus* to pass thro' it into the belly; and that wound, he supposes, was caused by a blow, tho' it did not hurt the external parts, nor make any impression on the tender *Embrio*: Mr. *Yonge* supposes that M. *Rhoonbuys* mistook the distended *Tuba* for a *Matrix*, as *Vesalius* did.

T. Bartholinus had such another extra-uterine *Fœtus* lapped up in a *Mola*, which he found in a woman's belly, and conjectures, that it was first conceived in the *Tuba Uteri*, vide *Centur.* 6. obs.

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obſ. 92. A.D. 1662. In the city of *Orange*, *D. Baldwin* and M. *De la Fort* found a fine male *Fœtus* without the *Uterus*; the report of this diſcovery is made publick by M. *Sachs*, in *Miſcellan. Curioſ.* vol. 1. obſ. 110; who gives another inſtance from the *Sileſian* chronicle, written by *Polinus*, as follows; A.D. 1581. A woman that had born 10 children in 15 years, conceived again and at the full time was delivered through an abſceſs of the left *Hypocondrion*, of a fine boy, who was baptiſed, and lived a year and a half; but the mother being in exquiſite agonies, died the third day after.

The anomalar blackneſs of the girl's face, was in *November* divided into a few dark, cloudy ſpecks, which appeared but ſeldom, and nothing ſo livid as formerly.

Mr. *Tonge* was told by a ſportſman, that he found in the paunch of a hare, two full-grown young ones, among the inteſtines, but almoſt rotten; as alſo three immature *Embrio*'s in the *Uterus*: The former, Mr. *Tonge* believes were certainly *Fœtus*'s broke out of the *Uterus*.

An Account of three Caſes of the Hydrophobia; *by Dr.* Mead. Phil. Tranſ. N° 323. p. 433.

ON the 20th of *April*, a mad bitch of the mungrel kind, was hunted in the ſtreets of *London*, when a lad of about nine years of age, ſtruck at her with a ſtick, upon which flying in his face, ſhe bit him in the right cheek, which was torn with a large wound to the middle of the noſe; a ſurgeon cured the wound in about 14 days time, by applying for the three firſt days *Theriac. Andromach. in Spir. Vin.* and afterwards dreſſing it with *Liniment. Arcæi*, & *Balſam. Terebinth.* no other care was taken, only a bolus of *Theriac. Andromach.* was given him every night, while under cure, and ſoon after he was bit, he was perſuaded to eat the whole liver of the bitch fried: He continued very briſk and well to the 22d of *May*, when he ſeemed dull and ſick, would eat no dinner, excepting a little boiled ſpinnage, walked out in the afternoon, and in the evening complained of his ſtomach and head; his mother gave him a ſmall glaſs of brandy, for he would drink nothing elſe; in the night he was very bad, ſtartled often, ſcreamed out as in an agony, eſpecially when deſired to drink, and complained miſerably whenever he made urine, ſaying *it hurt him*; the next morning he vomited up the herbs he had eat the day before, unaltered; Dr. *Mead* was ſent for that day in the afternoon, and found the patient in a perfect agony, all in a ſweat, trembling, toſſing himſelf up and down, talking con-

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usually, looking very wild; his pulse low, and sometimes quicker, then again slower; and his urine, made the night before, as well coloured as usual; the Dr. defired him to drink; he took a little in his mouth, but as it was going down, he threw it out with violence, saying, *it hurt him*; the patient again held a little in his mouth, and swallowed it by degrees, and gently, and with more ease, but was glad when it was over; he tried to suck the drink thro' a quill, but could not get it down in continued gulps, but stopped as soon as a very little was passed, still crying out, that *it hurt him to swallow it*: The Dr. presently declared the case to be desperate; however, blistering plaisters were applied to the back, and on each side of the neck, and a diuretic bolus of *Sal. Succin. Camphor.* and *Confect. Jujub.* was given every six hours; for he seemed, from the beginning of his complaint, to have a difficulty of urine: Next day, the 24th at noon, the Dr. found the patient much worse, he had raved all night, could not bear the sight of any thing white, and said, that if all the women in the room, who had white aprons would go out, he would be well presently; he said he would drink if he had some given him in a black cup; but when brought, he could not, tho' at the same time he complained he was dry, and pleased himself with talking of full pots; he eat some bread and butter heartily, but quickly vomited it up again, together with a frothy slime; he was dipped in a tub of warm water, and said he was not afraid of water, and was quiet in it for a little while; but he soon fell into a convulsion, which obliged us to take him out; the Dr. observed his eyes to grow more staring, and the pupil prodigiously enlarged; he was continually thrown with such violence from place to place, that it was very hard to keep him in bed; and being quite tired and spent, he fell into cold sweats, and died at four o'clock in the afternoon: The next day the Dr. opened the body, and examining the brain, throat, breast and stomach, he met with no extraordinary appearance any where, excepting that there was a great quantity of greenish viscid bile in the stomach.

The other patient was a very lusty vigorous man of 45 years of age, who had 10 weeks before been bit in one of the fore-fingers near the nail, by a little naked dog of the *Guinea* breed; on the eighth of *November* in the morning, he complained of a great sickness at his stomach, and vomitted green, and yellow choler; the next morning he took a dose of *Rad. Ipecacuanh.* whilst he was vomiting, he complained of a difficulty of swallowing, and to work off the medicine, he sucked the gruel given him, thro' a pece

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a piece of a tobacco-pipe; but he could not get down above a pint; and tho' he afterwards often tried this contrivance, yet all was to no purpose: On the 29th he had eight ounces of blood taken from his arm, and he took a bolus of *Theriac. Andromach.* with *Lap. Contrayerv.* The Dr. came to him on the 31st, and found him tied in his bed, raving mad, biting and spitting at the by-standers, crying out *murder*; and making an odd noise, as if he coughed up something from his throat; this motion the Dr. had also observed in the boy above-mentioned; and he supposes, this is what some authors have called barking: The Dr. observed that this patient had a palsy in his right arm; for he moved it only by the help of the other; and those who attended him observed, that this symptom began the day before, and that at the same time he had endeavoured to read, but could not, complaining of a mist before his eyes; as he seemed afraid of every body, so he shewed the greatest enmity to those, for whom at other times he was wont to have the greatest love and respect; the Dr. ordered a surgeon to take 20 ounces of blood from his arm, which he observed to be very thick and black; for a few minutes after this, he was very tame, but fell again into his outragious fit, in which he soon laid himself down, quite spent, and died.

The Dr. had an account, from a surgeon at *Stamford* in *Lincolnshire*, of a young man about 18 years of age, who died hydrophobus by the bite of a mad fox, that had been bit by a mad dog; the symptoms discovered themselves three months after the wound, which was upon the back of the hand, and being healed by the application of *Theriaca Andromach.* had left a small black scab behind: Three days before his death he was seized with a fever, for which he was blooded, vomited and blistered; he bit to pieces the glass wherein drink was given him; when he was dissected, the *Fauces* were found very much inflamed, the left lobe of the lungs was black, and the vesicles full of black blood, in some places the surface, which the blackness had not covered, appeared blistered, as if raised by *Cantharides*; the liver was hard, and of a yellow bilious colour: During the whole violence of the distemper, the *Penis* was observed to be continually erected, and as hard as a bone; this symptom is particularly taken notice of by *Caelius Aurelianus*: The surgeon who opened the body, slightly wounded his fore-finger with the knife, and was surprised to find, that it festered, and gave him much more pain than a greater cut had done at other times; something of the same nature likewise happened to the surgeon that dissected the Dr's patient; the following night his hand was seized with an

Erysipelas, attended with a great tension and pain; this was owing to a small wound made in one of his fingers a day or two before, from which in turning over the parts, he had rubbed off the plaister, and it did not go off, without the continued application of cooling and discutient medicines.

From all these accounts, it may not perhaps be improper to conclude, that the *Hydrophobia* is the effect of a particular kind of inflammation in the blood, accompanied with so great a tension, and dryness of the nervous membranes, and such an elasticity, and force of the fluids, with which they are filled, that the most common representations are made to the mind, with too great an effect, and the usual impressions of objects upon the organs cannot be endured; hence proceed that timorousness, unaccountable anxiety, and inquietude, which are always the forerunners of the *dread of liquids*; as also that pain in making water, and the strange aversion observed in the boy at the sight of any thing white, the *Retinæ* being really hurt by the striking of the rays of light thereon; nor is it hard to conceive, when the salival liquor is hot, and the throat inflamed and dry, that the swallowing of drink should cause such an intolerable agony; no more than it is, that when things are wrought up to this deplorable condition, the dismal tragedy should not last above three or four days at most, in which the patient is perfectly fatigued, and torn to death, by the violence of his actions and efforts.

An Experiment to produce Light *on the inside of a* Globe-glass *lined with melted Flowers of* Sulphur; *by Mr.* Francis Hauksbee. Phil. Trans. N°. 323. P. 439.

MR. *Hauksbee* melted in a ladle about half a pound of the flowers of sulphur, or sulphur sublimed, and pouring it into a globe-glass, he used it in all respects, as in the former experiments, with sealing-wax and pitch; and after this glass was exhausted, and motion and attrition given it, he expected as before, to have seen a light on its inside; but all he could do had no manner of effect thereon, to produce such an appearance, either when it was exhausted, or when replete with air; there was nothing to be observed but a very small weak light, which after a long attrition, shewed itself in that part, where the hand touched the glass; but when he came to look upon it, he found the sulphureous lining all in a body disengaged from the concave surface of the glass; As to the electricity of the globe lined with this sort of matter, after its attrition had been continued for some

time,

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time; and the glass become pretty warm (being full of air at the same time) the hoop of threads was held over it; but the attraction was very inconsiderable on the lined part, tho' the threads were pretty vigorously directed on the transparent side; yet not with such force, as when the glass is quite clear within, as this was not; because the fumes of the melted sulphur adhering to it, made it appear somewhat cloudy.

Mr. *Hauksbee* repeated this experiment with common sulphur, and took a quantity, nearly equal to what he had used before of the flowers, and melting it, he poured it into another globe-glass, which he used in all respects, as he had done the former; but when he had exhausted it, and given the usual motion and attrition, the effect was so surprisingly different, that one would scarcely think, it could proceed from the same sort of body; for the figure of his hand, and fingers appeared not only on its inside (tho' more faint and pale, than in the experiments of sealing-wax and pitch) but, on its outside their appeared a brisk purple light, so beautiful and agreeable to the eye, that it was a very pleasant sight; the strength of this light may be judged hence, that the lines of the palm of his hand, near those parts it touched, were easily discernible thereby; and were a small print placed at the same distance, he does not question, but it would have been legible without any great difficulty; and as this common sulphur differed vastly in that part of the experiment, already related from the former, so likewise in the latter; for when the hoop of threads came to be held over it (under the same circumstances, as in the other) they were directed towards it as vigorously, as in any experiment that had been made; the lined and transparent parts performed much alike; if there was any difference, it seemed to incline to that part lined with the sulphur; in this experiment likewise, as in the last, the sulphur was loosened, and separated from the glass, that contained it; which therefore cannot be urged, as any ways conducing to the unsuccessfulness of the former.

Mr. *Hauksbee* repeated this experiment with a large quantity of sulphur, and poured about two pounds of it melted into a globe-glass of the same size with the former, which was about five inches diameter; this when cold, contracted itself, and was loosened from every part of the glass, as in the former experiments; the sulphur covered more than half the inner surface of the globe, and its thinnest part, was about half an inch thick; towards the axis it appeared to be more than a full inch thick; this glass when exhausted of its air, was used in every respect,

as

as in the former; the light produced on its outside was very conſiderable, and attended with the ſame colour and vivacity as before; nor was that on its inſide leſs vigorous; comparing it with the former, notwithſtanding the thickneſs of the lining, it was at leaſt four times greater; but the figure of the fingers was not now ſo diſtinguiſhable as in the other; and on the part near the axis, as was hinted before, where the ſubſtance of the ſulphur was by much the greateſt, no light was produced; which might be owing in a great meaſure, to the ſlowneſs of the motion, and its weakneſs there, in reſpect to that which was made more remote from it, where the light was ſeen within; what was farther obſervable was, that the light which was viſible on its outſide only, appeared to be produced between the inner ſurface of the glaſs, and the convex ſurface of the ſulphur; for the ſulphur being looſened therefrom, gave liberty for the air to be taken from thence, as well as from the other parts, the light which was there produced, being reflected by the hard, poliſhed, and nearly contiguous body of the ſulphur, ſeems to *Mr. Hauksbee* to be the reaſon, why it appeared with ſo much vigour; this outer light would ſometimes break into branches, all over the lined part of the globe, in as odd and pleaſant a manner, as what was obſerved in former experiments, with the large globe-glaſs, upon admitting a little air: and what farther occurred in this experiment was, that when the attrition ceaſed, the globe continuing its motion, a great many ſparks of light would appear all round it, and ſo continue for ſome time, without any freſh attrition.

Coroll. Hence we may ſee, what remarkable changes may be produced in bodies, with reſpect to their electrical, and luminous qualities by their different managment and preparation; as here it is plain, that common ſulphur, which is plentifully endued with both theſe qualities, by undergoing the chemical fire, which ſublimes it into flowers, is almoſt entirely deprived of them both; perhaps by other management of the ſame body, this loſs might be repaired again; and it is poſſible, there may be chemical operations, which inſtead of impairing, may improve, and heighten theſe ſurpriſing qualities of bodies; nay, for ought Mr. *Hauksbee* knows, may give them *new* qualities, where they never were at all; as well as take them away, where they once were in a great degree of perfection; the powers of nature are not to be determined before hand by demonſtration, but to be explored by obſervation and experiment.

Microscopical Observations on the particles of crystallized Sugar, Minerals, and the Manner of observing the Circulation of the Blood in an Eel; by M. Leewenhoeck. Phil. Trans. N° 323. p. 444.

M. *Leewenhoeck* affirmed in a former *Transaction* that the particles of sugar-candy, consisted of two broad, and two narrow sides, and that the other, *i. e.* the top and bottom ran into a sharp point, like the figure of a wedge or chisel.

Plate VI. Fig. 11. ABCDEFGHIK represents a small bit of sugar-candy, of which one shall seldom see so perfect a figure; because they are almost always fastened to some other particles of sugar, so that we can only discover the superficies of one side thereof, as here in this figure HIEFG; but when it is taken out of the syrup, or liquor without being united to any other particles, the other side represented by ABCDK will also appear after the same manner: We also observe, that all the particles of sugar-candy, even that which comes from the *East-Indies*, if it be not too irregularly coagulated, and fastened to the sides of other particles, has generally, one side obtuse, and different from the other three, which have angles just like a square piece of wood, one of the corners of which is partly cut away, as appears at IK.

Fig. 12. LMNOPQ also represents a little particle of sugar-candy, which had been joined to others, at the side LMN, and at O there appears a very small particle of the candy, that seems to have been coagulated with the said Fig. when it was much smaller; and that particle appeared like mountain-crystal, and under that, there was another consisting of about 10 small crystals: For his further satisfaction about sugar-candy, and its coagulation in the syrup, M. *Leewenhoeck* took some powdered sugar, and dissolving it in water, he then boiled it so long, till he supposed all the water had evaporated; after which he placed it upon several glasses, to the end that he might observe the coagulation of the small particles thereof; some days after (this was in the month of *March*) he observed a great many regular figures, which lay coagulated in several shapes, but all of them as clear and transparent, as crystal, insomuch that they afforded a pleasant sight; he expected to have found them all of one, and the same shape, and that they would have appeared like Fig. 11. but, upon viewing them with a microscope, some of them appeared, as represented by Fig. 13. RSTV; this at first seemed somewhat surprising to M. *Leewenhoeck*; but when he considered,

that

that the particles of ſugar (of which ſome are ſeveral thouſand times ſmaller, nay, ſo ſmall, as to eſcape the ſight thro' a microſcope) do not appear to the eye in the ſame poſition, nor that its wedges are repreſented as in Fig. 11. by B C, or G F; but that on the contrary, the ſide which is ſhewn in the ſaid figure by C D E F I K, lies ſometimes uppermoſt, or undermoſt; then it is not ſurpriſing, if the ſame particle of ſugar-candy ſhall appear to the eye as repreſented in Fig. 14. by A B C D E F: In that above-mentioned particle of ſugar, he obſerved ſeveral ſtreaks, or fibres, that lay inwards, and which, by reaſon of the tranſparency of the ſugar, appeared plainly to the eye, as repreſented in the laſt figure, between D and C, and D and E, and ſo likewiſe from the center of the ſugar, where thoſe ſtreaks extended on each ſide to B and F: From this obſervation, M. *Leewenhoeck* concluded, that the ſugar increaſed from time to time, in proportion to the ſpaces between each ſtreak, or fibre: He likewiſe ſaw a few coagulated ſugar particles, that appeared in as regular quadrilateral figures as ever he had ſeen, one of which is repreſented by Fig. 15. G H I K, and withal as clear, and tranſparent as any diamond; it is likewiſe to be obſerved, that each of theſe figures 13, 14, 15, was no bigger, than a ſmall grain of ſand: The reaſon why, there were ſo many particles of ſugar, that had but one part of Fig. 13. was, as he ſuppoſes, becauſe they were coagulated with other particles of the like figure, inſomuch, that they hindered each other in their coagulation; but when they lie at ſuch a diſtance from each other, as that there is no actual contact of the parts, and yet they are coagulated, we can attribute that effect to nothing elſe, but a ſecret tendency, which the inviſible parts of the ſugar have to each other: In the middle of Fig. 13 and 15, he obſerved a clear particle, which was of the ſame ſhape with the whole body; whence he concluded, that the ſaid body was much ſmaller at its coagulation, but increaſed continually, by new acceſſions of matter round about it; and that in proportion to the number of circles, or circumferences, the body increaſed from time to time in bigneſs; and who knows, but that each circle was formed on a particular day, and in dry weather, and that at night it remained in the ſame ſtate: Theſe little figures retained their entire ſhapes, and cryſtalline appearances, as long as it was dry weather; but when it happened to be moiſt, or rainy weather, he obſerved a moiſture about the particles of the ſugar, which in dry weather, evaporated again; and then there coagulated a vaſt number of ſmall ſugar particles upon the larger particles, and thoſe were ſo exceeding

ſmall,

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ſmall, that a thouſand of them together were not ſo big, as one of thoſe particles repreſented by Fig. 13. *viz.* not ſo big as a ſingle grain of ſand, thereby all their beauty diſappeared; and to the end, that theſe little figures might retain their ſhape till they were delineated, he was obliged to carry both them, and the microſcope, before which they ſtood, in his pocket: Now ſince we ſee, that two different figures are coagulated from one, and the ſame matter, it is eaſy to conceive, that ſeveral other figures might be produced in the firſt coagulation, eſpecially, when any of the parts of theſe little bodies lie upon each other; and therefore, we ſhould not be ſurpriſed, to ſee in the coagulation of ſalts, ſeveral figures, produced from one particle of ſalt.

M. *Leewenhoeck*, upon examining the ſubſtance of a piece of mineral, ſaid to be very rich in gold, and brought from *Hungary*, found that the fine gold colour was nothing elſe, but ſulphur; there was alſo another piece, which was ſaid to be copper; one of theſe minerals was mixed with a little ſtony matter, juſt like particles of ſand, which ſeemed to be united, by ſome heterogeneous matter, to the other parts of the mineral; he ſeparated ſome of the ſtony matter from the reſt, and placing it before his microſcope, he found that ſome of the particles of which it conſiſted, had as ſmooth, and regular ſides and angles, as any poliſhed diamond can have, that is, when they were not united, or did not lie under others; but where there was an union of the parts, there appeared ſeveral ſuch circles, as in Fig. 13 and 15, ſome of them having particular ſides, one of which was twice as broad as the other: Theſe particular circles or rings M. *Leewenhoeck* ſuppoſed to be alſo occaſioned by the increaſe or coagulation of new matter; it was a very agreeable ſight, for they appeared as clear as cryſtal: Both the gold and the copper, that ſeemed to be in theſe minerals, were nothing elſe but ſulphur.

M. *Leewenhoeck* was formerly wont to ſhew the circulation of the blood in an eel, by putting it with its tail uppermoſt, into a long glaſs tube; but afterwards, he prepared copper plates of about a foot long, and ſeven inches broad, one extremity of which, of the extent of an inch, he bent, and at the other extremity he made a ſquare hole five inches long, and two inches broad, in which he put little glaſs plates, as clear, and as thin as he could poſſibly procure; upon ſuch a glaſs plate he put one of the ſmalleſt eels he could find, which were ſometimes as big, as one's finger; then he bound the head, and the beſt part of the body about with a linen cloth to the end, that the eel might not ſee, and then it would lie the ſtiller upon the copper plate, and

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he laid the tail upon the glass; and that part of the body of the eel, that is wound about with the cloth, he also fastened to the plate with a wire, that the eel might not wriggle itself off; the eel being thus placed upon one side of the glass in the copper plate, the microscope, thro' which he viewed the circulation, was fastened by wires, and screws on the other side, in such a manner, that it might be moved upwards and downwards, and every way: If people would use this method, M. *Leewenhoeck* does not doubt, but they might observe the same things in an eel, which he had done; and then if a person would view the arm, and carefully consider the pulse in the veins, he would certainly discover, that the blood which causes the pulse, proceeds from the hand.

The Bones of a dead Calf *taken out of the* Uterus *of a* Cow; *and a* Callus *supplying the loss of part of the* Os Femoris; *by Mr.* Sherman. Phil. Trans. N° 323. p. 450.

THIS cow had continued a great while in a lean, pining and wasting condition, and was reduced to so weak a state, that they concluded she would die; when of a sudden she began to eat, and thrive so very fast, that in six or eight months, she was so fat, as to be sold to the butcher; who when he killed her, found dry bones in her *Uterus*, there being no manner of moisture in the bag, as he called it, wherein the bones were contained: Mr. *Sherman* supposes, that the same digestive humour, which dissolved the skin, and muscular parts of the calf, might likewise dissolve the cartilages, and for ought he knows, even part of the bones: There are several such instances in anatomical authors, particularly, one of a woman, whose *Fœtus* dissolved so perfectly, that some of the bones made their way thro' the *Abdomen*, and what is more surprising, the same woman had children afterwards.

A young man about 17 years of age had a compound fracture on the thigh; Mr. *Sherman* was obliged to take out two inches of the substance of the *Os Femoris*, and yet nature, by keeping a due extension, in four month's time supplied such a *Callus*, that the part was not $\frac{1}{4}$ of an inch shorter than the other side, and the person was as strong as ever, and walked without any lameness.

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An Account of the great Froſt *in* 1708 *and* 1708; *by Mr.* Derham. Phil. Tranſ. N° 324. p. 454.

MR. *Derham* ſuppoſes, that this froſt was greater (if not alſo more univerſal) than any other within the memory of man; the froſt that happened in 1683 was the longeſt froſt, but this in 1708 tho' of ſhorter continuance, was more intenſe than that; for Mr. *Derham*'s thermometer was much lower on *December* 30th, than it had ever been ſince 1697, when he firſt began his thermometrical obſervations; and the thermometer in the repoſitory at *Greſham-College* was lower, than ever it was before; the particulars of its greateſt deſcent are theſe *January* 26; 1696, 41 degrees, *January* 5, 1683, 40 degrees, and *January* 3, 1708 43 degrees, and laſtly in Mr. *Patrick*'s thermometer in *London*, the ſpirits were 4 or 5 degrees lower than in 1683: In *London* the greateſt contraction of the ſpirits was on *January* 3, which was alſo an exceſſive cold day at *Upminſter*; but, the greateſt contraction in the laſt place was on *Dec.* 30. preceeding; the reaſon of the difference is, becauſe, Mr. *Derham*'s thermometer was always abroad in the open air, where no ſun-ſhine touch'd it; but, thoſe two thermometers at *London* were within doors, in rooms where no fires were made, and it is eaſy to obſerve, that the froſt does not preſently exert its greateſt force within doors, and when it does, neither does is ſo ſoon abate its force within doors, as without: Mr. *Derham*'s obſervations about the intenſeneſs of the cold were confirmed from other places in the ſouthern parts of *England*; particularly, he found them to agree with ſome obſervations made by Mr. *Creſſener* at *Streatham* in *Surrey*: Mr. *Derham* obſerved, that the deſcent of the ſpirits in his thermometer on *December* the 30 was, within one-tenth of an inch as great, as the deſcent effected at another time (and that in a cold day too, becauſe artificial freezing is leſs vigorous in a warm day) with artificial freezings made both with ſnow, and ſalt, and likewiſe with ſnow, and ſpirits, both which mixtures he made uſe of ſeveral times, and found them nearly of equal power; if there was any difference, he ſometimes thought the preference due to the mixture of the ſpirits of wine with the ſnow: It is well known, that we can in ſummer freeze with ice and ſalt, and the ſame may be then done with *Sal armoniac*, diſſolved in water; but we cannot by theſe means produce at that time ſo intenſe a froſt, as in winter, eſpecially in a very cold day.

Notwithſtanding, the froſt was ſo extremely rigorous in the ſouthern parts of our iſle, yet the northern parts felt little

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thereof: Mr. *Derham* received ſeveral informations from thence, which all agreed, that the winter was no ways extremely cold there, but like other winters; and in particular, the Biſhop of *Carliſle* writ an account from *Roſe* Nov. 5. 1709. as follow's: 'January laſt, ſays he, I had a ſufficient opportunity to obſerve 'the froſt, and cold being more intenſe in the ſouthern parts, 'and the ſnow much thicker, than here; I began my journey to 'London on the 26 of that month, three days before the thaw, 'and for ſeveral miles, near the banks of the river *Eden*, in both 'the counties of *Cumberland*, and *Weſtmoreland*, my horſes 'hardly ever trod upon ſnow; when we came to *Stanemoor* on 'the confines of *Yorkſhire*, we found the ground covered pretty 'thick, and ſtill deeper the farther we came to the ſouth; none 'of our rivers, or lakes were frozen over; and the extraor-'dinary flocks of ſwans, that reſorted hither (nothing like it 'having been ſeen by the oldeſt man living) was a ſure argument, 'that the temperature of the climates was ſtrangely inverted. 'The other account was from *Edinburg*, *Nov.* 5 1709, from Sir 'Robert *Sibbald*; I can learn ſays he, no extraordinary effects of 'the cold ſeaſon here; it was a long winter; the cold came early 'in *October*, and continued till near *May*; there was a deal of 'ſnow, which lay long on our ſouth hills near this place; we 'had not much froſt to ſignify, nor did it laſt long: And as in 'Scotland, ſo in *Ireland*, the froſt was very favourable; as ap-'pears from Mr. *Molyneux*; *viz.* we had here, ſays he, a harder 'winter than uſual, but I ſuppoſe they did not ſuffer ſo much as 'their neighbours; they had two or three pretty ſharp froſts, and 'ſome ſnow, but not of any remarkable continuance'. M. *Scheuch-zer* obſerved the cold to be as exceſſive and unuſual at *Zurich*, as it was here with us; the cold in *Italy* was ſo great, that for 20 years paſt they had not felt a greater, and on *Twelfth-day* it wanted but half a degree of extreme; as to the northern parts M. *Otho Sperling* writ from *Copenhagen*, that it was *Hyems atro-ciſſima*; and Dr. *Judichar* affirmed that the ice in the harbour of *Copenhagen* was 27 inches thick; and that on *April* 9. 1709. N.S. people had gone over between *Schonen* and *Denmark* on the ice; by M. *Roemer*'s obſervations it appears, *ſuch a froſt had not been known in the memory of man in theſe countries, and that the froſt on* January 7, *and* February 23, 1708-9, *did very nearly approach the point of artificial freezing*: In the northern parts of *Germany* they had alſo the ſame fate with their neighbours of *Denmark*, as appears from an academical exerciſe in the univerſity of *Hall*, *June* 13, 1709. by *G. Remus*, entitled *Conſideratio Phyſico-mathematica, Hyemis proximè præterlapſæ*, &c. M. *Remus* diſ-tributes

tributes that winter into five periods, the first of which he begins at *October* 19, 1708. N. S. at which time the cold weather began with them at *Hall*, the northern winds blowing then, and frosty weather accompanying it; but at *Upminster* it began somewhat sooner; for the winds were northerly all the latter end of *September*, and there was a hoar-frost on *Michaelmas* and the following days; after which, for a great part of *October* to the 23d, the weather was for the most part hoar-frosty, or frosty, very agreeably to M. *Remus*'s observations; he places the end of this first period on *November* 3. The second period, which with its interval takes in *November* and *December*, Mr. *Derham* found pretty much to agree with his own observations, the weather being often warm or cold at *Upminster*, as it was at *Hall*, and the winds also not very different; only Mr. *Derham* observed, that the cold in one place commonly preceeded that in the other; and the violent wind M. *Remus* says, blew the night preceeding *December* 13. N. S. was not perceivable at *Upminster*, till the second day after about noon, at which time it had spent itself much, and was only a brisk easterly wind, but no storm: The third period begins on *January* 5, N. S. of which M. *Remus* says, 'the scene was suddenly changed, and to the surprise of all *Europe*, this period 'began with an extraordinary and almost unusual cold.' at the same time the wind and weather began to change at *Upminster*, as M. *Remus* says it did at *Hall*, and the cold also began to increase.

Here follows a table of the depression of the spirits at *Hall* and *Upminster*.

Day of the Month. O. S.		Degree of the Thermometer at *Hall*, 10 h. p. m.	Degree of the Thermometer at *Upminster* at 9 h. p. m.
Decemb.	27	84½	65
	28	84½	75
	29	92½	58
	30	100	45
	31	All within	52
Jan.	1	the ball.	63
	2		55

It

It is to be obſerved that the ſcale of the thermometer at *Hall* runs downwards, from ſome point above, towards the ball, or bottom of the ſtalk; but the degrees of Mr. *Derham*'s thermometer, begin at the top of the ball, or which is all one, at the bottom of the little tube, or ſtalk, and ſo upwards, every degree being one tenth of an *Engliſh* inch, and the freezing point, at 32 degrees, equal to eight inches two tenths from the ball; and the moſt intenſe cold at 44 degrees.

From the foregoing table it may be perceived, that the froſt at the beginning kept a pretty equal pace in both places; and Mr. *Derham* had reaſon to think, that it did the ſame, the greateſt part of its duration: M. *Remus*'s third period ends *January* 25, N. S. with an weſterly wind and a thaw, which held for a few days; at *Upminſter* the wind was ſoutherly at the ſame time, with a thaw likewiſe accompanying it for a few days: M. *Remus* begins the fourth period on *January* 31, N. S. in which Mr. *Derham* obſerved a great agreement between their obſervations, as to the cold; and thoſe days on which M. *Remus* marked the weſterly winds to have been ſtrong, it was the ſame at *Upminſter*; and there was alſo ſome, but leſs, agreement, in the coaſting and the ſhifting of the winds throughout this period: The fifth and laſt period M. *Remus* places between *February* 17, and *March* 17, N. S. in this, he ſays the cold weather returned, and continued long; and it did the ſame at *Upminſter*; but as to the end of this period, Mr. *Derham* found ſome difference, and ſome agreement between their obſervations; the ſnow was more with them than with us; the winds changed with us from the eaſterly points, to the weſterly and ſoutherly points, a day or two ſooner, than with them, then again agreed with them; and ſoon after veered about to the eaſterly and northerly points, as it did with them; and Mr. *Derham* alſo further obſerved, that when the winds agreed in both places, the wind at *Upminſter* was of ſome force: As to the warmth of the weather all this time, Mr. *Derham* found a pretty deal of agreement; only, as the wind changed two days ſooner at *Upminſter*, ſo we had the mild weather M. *Remus* mentions, two days ſooner; then it grew colder at *Upminſter*, as M. *Remus* ſays it did with them; and whereas, he marks *April* 13. N. S. to have been the firſt day, on which the ſpirits roſe to the point of warmth, Mr. *Derham* found by his thermometer, that the preceeding day had been as warm as that, as alſo the following days, and each of them warmer than any had been all the preceeding winter; tho' there had been ſeveral warm days before that time, particularly, *March* 12, 13, 14, 18, 19, 28. O. S.

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28, O. S. but the rest in that month were cold for the most part.

As to the effects of this frost, the waters were frozen in several places to an extraordinary depth, tho' Mr. *Derham* hardly believes to that depth, as in the long frost in 1683, when the *Thames* was frozen in such a manner, that above bridge several booths were erected, fires made, and meat dressed; and on *January* 10. 1683, Mr. *Derham* himself saw a coach and 2 horses drive over the river to *Southwark*, and back again, a great number of people accompanying it; but in the winter 1708, the case was vastly different, according to the account Mr. *Derham* receiv'd from Mr. *Lowthorp*; 'who saw several people cross the *Thames*, 'at some distance, above bridge; but, that was only towards 'low-water, when the great flakes of ice, that came down, 'stopp'd each other at the bridge, 'till they form'd one continued 'bed of ice from thence, almost to the *Temple*; but, when the 'flood came, the ice broke, and was all carried with the current 'up the river; he was told the like happen'd between *Westmin-* 'ster and *Lambeth*, a little above *Whitehall*:' As for other waters they also had their share, especially, where they lay expos'd to the northerly, and north easterly winds; nay, the sea-waters themselves did not escape, but, were cover'd with ice in several places near the shore, in harbours, and where they lay calm and still; as in the harbour of *Copenhagen*, and in the sea between *Schonen* and *Denmark*; and Dr. *Newton* inform'd Mr. *Derham*, that the sea was froze both on the coast of *Geneva* and *Legborn*: As for the northern parts of *Germany*, the above-mention'd dissertation of M. *Remus* gives the following account; *viz.* 'The waters were frozen into ice below the usual depth, 'and other liquids were congeal'd, that at other times are never 'so, even in the middle of winter; tho' the waters of a spring in 'a certain village of *Silesia* be cold in summer, and warm in 'winter, yet, this winter it was covered with a pretty thick crust 'of ice; and even, the public news often gave account of mineral 'waters being frozen, tho' not the hotter sorts; icicles were seen 'sticking to the salt springs at *Hall*, which had not happen'd in 'an age before: D. *Breynius* inform'd M. *Remus*, that the sea it-'self, as far as his armed sight could reach, was cover'd with 'ice, even on the eighth of *April*; and that, upon exposing to 'the open air a strong lee of pot-ash, which is never said to 'freeze, he found it soon turn'd into ice: Moreover, a certain 'friend of his had likewise observed, that the dephlegmated spi-'rit of tartar was frozen: The *Observationes Hallenses* give an

'account,

' account, that the ſpittle was hardly out of the mouth before it ' was froze; rivers were thrice frozen, even ſuch as the cold, by ' reaſon of their rapadity, could not affect at other times:' Thoſe effects Mr. *Derham* was apt to think the waters felt, not only in *England*, *Denmark*, *Germany*, *France* and *Italy*; but likewiſe in all the northern parts of the globe, excepting *Scotland*, *Ireland*, and probably ſome other iſlands, or places near the ſea; tho' even ſome of theſe appear from the foregoing account to have ſuffer'd much; this univerſality of the froſt, Mr. *Derham* ſuſpected, from the great numbers of divers kinds of birds (utter ſtrangers to theſe parts, and many of them inhabitants of the northern colder climates) which were ſeen, and kill'd in ſeveral parts of *England*; in the *Eſſex* marſhes we had ſeveral wild ſwans, brent geeſe, ſeveral of the rarer gull-kind, and divers other ſorts of birds, utter ſtrangers to theſe parts; and the following birds were kill'd within four or five miles of *Coln*, St. *Aldwin*'s, or *Edwin*'s in *Glouceſterſhire*, between the beginning of *November*, and the latter end of *March* 1708, which were never found there in moderate winters.

1. *Lanius cinereus major*, the larger butcher-bird, or mattageſs; ſometimes ſeen in *Derbyſhire*, but common in *Germany*, as Mr. *Willoughby* ſays. 2. *Fringilla montana*, the brambling. 3. *Numenius, ſive Arquata*, the curlew; theſe birds, tho' ſtrangers to the inland parts, Mr. *Derham* had ſeen common enough on the *Eſſex* coaſt; and Dr. *Woodward* affirms, he ſaw them ſeveral times the winter, 1708, at the poulterers in *London*. 4. *Gallinula Erythropus major*, the redſhank, or poolſnipe. 5. *Gallinula hypolemos Geſneri*, the ſand-piper. 6. *Schæniclos*, the ſtint. 7. *Corvus aquaticus minor, ſive Graculus palmipes*, the ſhag. 8. *Merganſer*, the gooſander. 9. *Mergus cirratus, longiroſter*, the dun diver. 10. *Mergus major cirratus*, the ſmew, or white nun. 11. *Colymbus major*, the greater loon. 12. *Larus major*, the greater gull. 13 *Cygnus ferus*, the elk, or hooper, or wild-ſwan. 14. *Brenta*, the brent-gooſe. 15. *Anas niger Aldrovandi*, ſeldom ſeen in *England*, but common in *Norway*. 16. *Tadorna*, the ſhell-drake, or burrough duck. 17. *Anas fuligula prima Geſneri*, the tufted duck. 18. *Anas fera fuſca Geſneri, Penelops Veterum*, the poker. 19. *Anas Platyrhynchos mas Aldrov.* the golden-eye. 20 *Platyrhynchos roſtro nigro & plano*, the gadwal.

In the above cited diſſertation of M. *Remus*, we are told, how animals ſuffered both with them, and in other places; *viz.* ' That ' the freſh-water-fiſh in thoſe parts were killed every where, and that

'that a vaſt deſtruction befel their ſmall birds; both which 'happened alſo at *Dantzick*, nay ſome affirmed, that they ſaw 'birds, as they flew along, drop down out of the air, their ſtrength 'failing them; that the *Luſatia* letters gave an account, that ſe-'veral cows were frozen to death in their ſtalls; and ſome travel-'lers on the road, were quite frozen to death, others loſt their 'hands, feet, noſes or ears; and ſome fainted away, and were in 'great danger either of life or limb, when brought too ſoon near 'the fire; of theſe particulars he gives ſeveral inſtances from 'news-papers; as of two gentlemen and a ſmith in *England*, 'and above 60 men and ſeveral cattle near *Paris*; and the like 'at *Venice*, and 80 *French* ſoldiers near *Namur*, all killed on the 'road with the cold.' Whether any ſuch perſons periſhed in our roads in *England*, Mr. *Derham* was not certain; but there was an account of ſome that did, particularly, of poſt-boys, and likewiſe ſome drovers; ſeveral of our freſh water fiſh were alſo deſtroyed in ponds, that were ſhallow, and eſpecially if long frozen over; ſome for want of air, where the ponds were not kept open, and others with the cold air at the holes in the ice, where they came in great numbers to breathe; Dr. *Newton* gave an account, 'that ſome marines on board our men of war on the '*Italian* coaſt, died of the cold; and that ſeveral loſt parts of 'their fingers and toes.'

But the greateſt ſufferers in the animal kingdom, were birds and inſects; robin-red-breaſts, which were numerous before the froſt came on, were afterwards very ſcarce, only here and there one was to be ſeen; nay notwithſtanding their recruits the follow-ing ſummer, yet ſtill the ſucceeding winter, their ſcarcity remain'd; both wood and ſky-larks, which us'd to be very numerous, became in a manner rarities the ſucceeding ſpring and ſummer, only one here, and another half a mile or a mile off, and their ſcarcity continued for ſome time after; but whether this was an univerſal calamity, that befel that family of ſmall birds, or whether it only happened to the *Eſſex* larks, or whether they were not driven from theſe parts by the froſt, Mr. *Derham* could not ſay; becauſe he had been informed, that in ſome other counties of *England*, which abound in large, common plowed fields, and where larks are uſually more numerous, than in *Eſſex*, they had had large flights of larks in the winter $17\frac{28}{29}$; and he was told by the *London* poul-terers, that they had larks from almoſt all parts of *England*, and had not received the following year, a quarter, nay ſcarcely a tenth part of the larks they uſed to have, by reaſon that the froſt had killed them, as the bird-catchers ſaid: In the inſect tribe,

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Mr. *Derham* particularly obſerved the *Pediculus Pulſatorius*, or *Fatidicus*, or *Death-watch*, to be great ſufferers; notwithſtanding the great precaution and art of that inſect, to ſecure itſelf againſt hard weather, in dry places within doors, under downy light duſt, &c. yet they ſeemed to be great ſufferers by the froſt; for few of them appeared the following ſummer; and in places where they were wont in *July* to be very ſonorous with their ticking noiſe, only now, and then one was heard; a manifeſt proof of their being either killed, or rendered leſs prolific and venereous.

But among all the ſufferers by the froſt, the vegetables were the moſt univerſal, few of the tenderer ſorts eſcaping; about *Upminſter*, bays, roſemary, cypreſſes, myrtles, moſt of the *Phyllerea*'s, yea even junipers, among the ſhrubs; and arti-choaks, colly-flowers, and a great many other olitory plants ſuffered very much; in a word, ſo great was the damage done among the gardens, that Mr. *Derham* was informed by the *London* gardeners, that ſome of them loſt to the value 80, 100, yea, 200 *l*; but the moſt exact account he had was from Mr. *Bobart*, botaniſt of the *Oxford* phyſic-garden, who obſerved that the damages of this froſt did not come up to thoſe of that in 1683, which being of longer continuance, cleft oaks, and the bodies of vines, &c. but in the froſt of 1708, or 1708-9, there were intervals of relaxation beſides ſeveral conſiderable falls of ſnow, which proved a good defence to ſeveral plants; but the ſnow melting, and the cold withal continuing, proved of bad conſequence to ſeveral bulbous and tuberous roots, and to a great many other things; but ſays he, 'the ſharp dry and piercing winds from the north, and north-eaſt, 'were very deſtructive to ſeveral of the ornaments of our gardens, 'which before ſeemed to be almoſt naturalized to our climate; 'as the cypreſs, bays, roſemary, *Alaterni*, *Phyllirea*'s, *Arbuti*, '*Lauruſtines*, &c. As alſo to moſt of our fruteſcent herbs, ſuch 'as lavenders, abrotonum's, rue, thyme, and ſeveral others of 'the like ſpecies, eſpecially ſuch as had their heads above the 'kind covering of the ſnow; and not only ſuch exotics, but ſome 'of our own natives, as is viſible in moſt of our fuzze-fields, and 'divers hollies, eſpecially thoſe of the finer ſtriped kind, felt the 'ſmart of the rigour of the ſeaſon, by the loſs of their leaves, 'and ſometimes of their lives; and what, ſays he, has been more 'obſervable this year, than other years is, that the ſap of our finer 'wall-fruit-trees, as peaches, nectarines, apricocks, &c. was congealed and diſordered in ſuch a manner, that it became ſtagnant 'in the limbs, and branches, and proved equivalent to chilblains

'in

'in the human body; and in too many parts of the tree, turned 'to ſo frequent mortifications, that it is very much to be doubted 'whether ſufficient vigour is ever to be expected from them, to be 'worth their ſtanding, notwithſtanding their weak endeavours 'of ſhooting, and recovering of their maladies; and it is no leſs 'extraordinary, that the very buds in theſe finer trees, as well 'leaf buds as bloſſom-buds (which are but the *Ovaria* of the ſuc-'ceeding fruits) were quite killed, and dried into a farinaceous 'matter, by the exceſſive ſharpneſs of the cold, before they grew 'out, tho' life remained in the branch; the plumbs, being more 'hardy, yielded their bloſſoms well enough; but thro' the 'chilling wets, before-mentioned, which happened to be too 'plentiful about that time, and the great defect of nutritive 'warmth, they grew weak, and their little ſtalks or pedicles lan-'guiſhing, and turning yellow, they generally dropped off, and 'came to nothing: It might, ſays he, have been reaſonably ſup-'poſed, that ſuch a cold, conjoined with repeated wets, ſhould 'have deſtroyed the noxious inſects, which uſually infeſt the firſt 'produce; but even this year they proved vivid, and too nume-'rous amongſt the apples and pears, eſpecially the former, whoſe 'bloſſoms, as well as leaves, have been too copious food for theſe 'voracious eruca's, whoſe *Ova* all the winter lay ſo dry in their 'bags, or pellicles, that ſo many of them eſpaced from being fro-'zen, as in ſeveral places to be numerous enough to deſtroy the 'whole verdure: Fig-trees, ſays he, whoſe ſofter texture was 'more eaſily penetrated, ſuffered much, moſt of them being cut 'down; ſeveral exotic greens, and rare plants from *Afric* and 'other warm climates, ſuffered very much in ſuch ſtoves, and 'conſervatories, as were too ſparingly ſupplied with fire.' What Mr. *Bobart* obſerved concerning the deſtruction of wheat, Mr. *Derham* believes was a general calamity, as that likewiſe the particulars, he takes notice of, were much the ſame in other places; *viz.* 'that where the land was poor, and expoſed to the 'cold, that there the wheat was killed, that ſeveral fields of 'wheat eſcaped tolerably well on the warm ſide, whilſt the other 'ſide was quite killed with the extremity of the cold:' By the warm and cold ſides, Mr. *Derham* ſuppoſes, he means the ſunny and ſhady ſides; but in *Eſſex* the wheat ſuffered rather more on the ſouthern ſunny ſide, than on the northern; becauſe as Mr. *Derham* ſuppoſes, the ground was ſomewhat opened by the ſunſhine, and the covering of ſnow being melted, it was thereby expoſed to the ſeverity of the nocturnal froſt; upon which account ſome ſkilful obſervers affirmed that vegetables ſuffered more from the

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ſun than from the froſt: Mr. *Derham* obſerved in *Eſſex* about *Upminſter*, that ſeveral ſmall fields of three or four acres of wheat, eſcaped pretty well, where they were fenced with thick high hedges againſt the cold winds, eſpecially where covered long with ſnow; at leaſt they eſcaped better than other parcels of land expoſed to the winds, that diſlodged the ſnow, and encreaſed the cold; and at *Upminſter* the beſt pieces of wheat were ſuch, as lay on gentle declivities fronting the weſt or ſouth-weſt, eſpecially when defended on the eaſt or north-eaſt ſide by a hill, or a wood, which fenced off the cold, piercing eaſterly, and north eaſterly winds: And not only ſhrubs, and plants ſuffered by the cold, but in ſome places the larger trees; which was owing not ſo much to their being frozen, as to the winds ſhaking, and rocking them at the ſame time, which rent and parted their fibres: Theſe were ſome of the moſt remarkable effects of the froſt on the vegetables of the more ſoutherly parts of our iſland, the northern parts eſcaping better, as appears by Sir *Robert Sibbald*'s account; *viz.* 'the corn did not ſpring 'up, nor ripen ſo ſoon, as uſual; but there enſued a plentiful 'harveſt, and ſafely brought into the barns and yards; and the 'price of victuals, which was high, falls lower daily; and no 'greater numbers died than uſually in former winters': The effects of the froſt were much the ſame on vegetables, in the more ſoutherly parts of *Europe*, as in ours: 'In *Italy* according to 'Dr. *Newton*, almoſt all the lemon, and orange trees, with thoſe 'of the like kind, and a great many olive trees, are deſtroyed 'by the froſt; the leaves of the bay-trees have the ſame colour 'now, as all others have, when they are falling in *October*'; beſides the Dr. gave an account of a diſaſter that happened at *Florence*; viz. 'on the ſide of a hill, where formerly were ſe-'veral buildings; which falling down twice, by the earth giving 'way, a wall was erected in the time of the preſent great duke's 'grandfather, with an inſcription on the wall, which ſeparates 'the ground from the next ſtreet, that for the future, no perſon 'ſhould build there; after the great froſt, this wall was alſo fallen 'down; the hill is full of ſtones, and people here ſuppoſe, that 'as theſe increaſe, the ground is puſhed forwards, and thereby 'thrown down; but I am apt to think, the froſt might have a 'great concern herein': Another accident happened at *Piſa*, where ſays he, 'upon the melting of the ſnow, and upon the 'great rains which fell after the froſt, tho' the *Arno* did not 'ſwell over its banks at *Piſa*, yet the water at ſome diſtance 'from the river, in a middle row of houſes, betwixt the river

'and

'and the great ſtreet on the north ſide, broke out with great vio-
'lence, and if it had not been immediately perceived, and the
'breach ſtopped, by throwing in a great quantity of bricks and
'timber, that part of the town might have been in danger of
'being drowned, where the palace, and the public ſchools, or
'the *Sapienza* ſtand: Dr. *Michael Angelo Tilli* the botanic
'profeſſor at *Piſa* informed Mr. *Derham*, that the froſt de-
'ſtroyed a vaſt many trees both in city and country'. In *Switzerland*, amongſt the high *Alpine* ridges, they felt dire effects of the froſt, yet ſome places were ſo lucky as to eſcape, according to the account given by M. *John Scheuchzer* of *Zurich*; *viz.* 'the diſmal effects, which our trees, even the largeſt, eſ-
'pecially the walnut-trees and vines felt laſt winter from the
'froſt, were not at all ſenſible in ſome places, defended towards
'the north with very high ridges; the trees and vines at *Veſena*
'near lake *Rivarius* were ſafe and untouched, ſo that they had
'there a plentiful vintage, whilſt we had none at all; the walnut-
'trees were loaded with fruit, as alſo the other trees, as if they
'had grown in a different climate from the neighbouring places;
'the inhabitants of a certain village called *Vettis*, lying at the
'foot of *Galanda*, a very high mountain on the confines of the
'*Griſons*, affirmed that they had ſcarcely ever felt a milder win-
'ter, whilſt thoſe of *Valentia*, the next village, during the ex-
'tremity of the cold, being quite precluded from a communica-
'tion with each other, were apprehenſive that all the inhabitants
'of *Vettis*, had periſhed with cold; on the other hand the
'woods, that lay expoſed to the north wind, and conſiſted of
'ever-greens, ſuch as firrs, yews, and larch-trees, became of a
'reddiſh colour, as if they had been ſcorched and ſtripped of
'all their leaves': Laſtly, as to the northern parts of *Germany*, the caſe was much the ſame there, as with us in *England*, as M. *Remus* informs us; 'the cold deſtroyed great numbers of
'trees and ſhrubs, that appeared with their heads above the ſur-
'face of the ſnow; the cherry, apple, and plumb trees ſtood out
'the rigour of the ſeaſon: In the month of *March* Dr. *Wolfius*
'obſerving ſeveral boughs of trees with a microſcope, found that
'the fibres were entire, and full of ſap; the bloſſoms were nu-
'merous on the cherry trees, but not ſo on the apple trees, *&c.*
'The almond, peach, and apricoc-trees, and the roſe-buſhes
'were almoſt all deſtroyed; the pear-trees ſuffered a great deal
'of damage; the vines that were buried deep in the ground, and
'ſufficiently defended from the rigour of the cold, eſcaped, whilſt
'the reſt that were not ſo, were quite deſtroyed; ſoon after the
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'vernal equinox, when the ſnow and ice were diſſolved, 'Dr. *Wolfius* obſerved, that the bark, wood, and pith of ſuch 'trees, as the cold had affected, as the pear, and apricoc-trees 'were become blackiſh; upon obſerving thro' a microſcope the 'ſhoots of the preceeding ſummer's growth, their fibrils were 'found broken aſunder every where, as they are in rotten wood; 'but in the other boughs there was no ſuch thing to be ſeen, 'only they were deprived of their ſap, and verdure; for about 'the middle of *April* when the trees were cheriſhed by the 'heat of the ſun, young buds ſhot forth in ſeveral places from 'the older wood of the apricoc-trees, and in ſome from the 'younger wood, where the bloſſoms ſhould have been; in others 'there were no ſhoots at all; all the buds of the pear-trees had 'opened, and the bloſſoms appeared, yet for the moſt part de-'prived of their uſual vigour; at that time the bark attained to 'its full verdure; the ſubſtance of the wood, being blacker from 'the center of the pith towards the circumference, recovered its 'white colour; the fibrils of this year's growth were ſtill black; 'but viewing them thro' a microſcope, they appeared turgid 'with ſap, like the ſame fibres in the cherry and apple-trees, 'which the cold had not touched; it is true the pith under the 'buds was in ſeveral places tinged with an unuſual blackneſs, 'yet the root of the bud, which was ſhot into a ſprig appeared 'thro' the microſcope, very turgid and verdant: It was obſerv-'able, that as the plumb-tree eſcaped the cold, ſo likewiſe did 'the buds of the apricoc-trees ingrafted into it, which were 'now become into large leaves, tho' not one of the apricoc-trees 'themſelves had eſcaped'.

The ſun being the fountain of the heat, enjoyed by the earth, and that heat not being always the ſame M. *Remus* enquires into the reaſon, why it is not ſo: The variation of the mutual diſtance between the earth and the ſun at the *Apogæum* and *Perigæum*; the mutation of the earth's place, in reſpect of the heavens, or its being removed to a greater diſtance from the ſun, and the obſtruction of the ſolar rays by the ſpots on the ſun, all theſe (after ingenious enquiries and calculations) he rejects; and as to the true cauſes, having aſſigned good philoſophical reaſons for the perpendicular rays warming more than the oblique; for the wind cooling the air, and the north and eaſt more than any other winds, *&c.* he then enumerates what he takes to be the proper cauſes in theſe words: 'It appears from what has been 'already ſaid, what the cauſes are that muſt contribute to pro-'duce cold in winter; *viz.* with reſpect to the ſun, there is

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'requisite a vast distance from the zenith or vertical point, and 'a short stay above the horizon; and with respect to the earth, 'the atmosphere must be replete with vapours and clouds, the 'winds must be easterly and northerly, especially such as blow 'with violence; but above all it is necessary, that the action of 'the sun be interrupted for a long time, and then especially when 'the causes of cold do concur:' M. *Remus* having thus assigned the causes, he then applies them to his five periods, and the more remarkable accidents that occurred therein.

After all, notwithstanding Mr. *Derham* approves, for the most part, of M. *Remus*'s causes, as being those, which are the common and ordinary ones; yet he takes it that there are some other more hidden and extraordinary ones, which M. *Remus* has not reached; for all his causes very commonly concur in other winters, without the same effects, as in 1703; yea, the next succeeding winter 1703 besides what is common to all winters, the obliquity of the sun's rays, &c. the winds were as much northerly, and easterly, and as strong, and there was as much dark weather, and all these likewise concurring together, as happened during the great frost, and yet there was no more than ordinary severe weather; but as to misty, cloudy, dark weather, which our ingenious author reckons among his principal causes, Mr. *Derham* is so far from taking it for a cause, that he rather supposes it to be the reason, we have not more frequent severe frosts, at least in our islands, surrounded by the warm vapours of the sea: Clouds and vapours do indeed, intercept, and keep off the rays of the sun, and probably imbibe, and retain a great deal of warmth themselves; nay perhaps they may, as he says, reflect back some of the solar rays; but we constantly find in winter, that the fewer the exhalations are, and the clearer the air is, and after the warmth of the sun by day, the sharper the frost is at night.

This much seems reasonable to Mr. *Derham, viz.* that the great mint of meteors being the superior regions of the air, and the terraqueous globe, being the source of exhalations, in those two places we are to enquire for the farther, and more considerable causes of the late frost; and in the 14 years observations, and upwards, Mr. *Derham* made of the weather, &c. he found a great deal to be attributed to the increase, and decrease of the cold of the upper regions, as also to the internal dispositions of our globe, at least to the larger or smaller quantity of vapours and exhalations; but Mr. *Derham* had not hitherto made sufficient observations to clear up and demonstrate his hypothesis.

Micro-

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Microscopical Observations on the Configuration *of* Diamonds, *by M.* Leewenhoeck. Phil. Trans. N° 324. p. 479.

M. *Leewenhoeck* took a small polished diamond, and broke it to pieces; but he observed nothing more in the broken particles thereof, than in those of common glass: he afterwards placed before his microscope a small rough diamond, and observing it more particularly, he concluded, that all those streaks, or fibres, which he saw therein, were nothing other than the several coagulations, or accessions it had received from time to time, and that in a very short space of time.

Plate VI. Fig. 1. A B C D E F represents a small particle of a little diamond, as it appeared thro' a microscope; in which between A and B, as also between C D E and F, you may observe a great many lines, or fibres, each of which M. *Leewenhoeck* supposes to be occasioned by the increase, or accession of new matter. Now that the increase of diamonds is made in such a manner, we may conclude the rather, because the same thing happens in the coagulation of several salts. M. *Leewenhoeck* took some of these particles several times, and laid them upon burning wood-coals, till they were red-hot, and then threw them into water, to see whether they would burst to pieces, or whether there would be any separation of matter therefrom; but that never happening, he concluded that there was no air, nor any moisture shut up within them.

Fig. 2. G H I K L represents a particle of a diamond, as it appeared to the sight, after he had made it red-hot, and slak'd it in water several times; in this likewise you may observe several small streaks, or fibres, between L and G; and when he observ'd it the last time, after taking it out of the water, it appear'd between L G H and I, just as if some small scales had been separated from it, resembling the shining, or glistering parts, which he had often observed in several stones, and particularly in the large flint-stone brought from *Greenland* for ballast, when its crystalline, or diamond transparency is gone.

Fig. 3. M N O P Q R represents a particle of a diamond, as it appeared thro' the microscope after it had been several times made red-hot, and thrown into cold water; in the middle of this particle might be perceived such slits, or cracks, as resembled the top, or cieling, of an unwainscotted church within-side, which was an agreeable sight; but they could not be so well traced by the painter; but whether this appearance was natural to the diamond, or whether it proceeded from breaking it into pieces,

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pieces, M. *Leewenhoeck* could not determine; but he ſuppoſes, that it was not occaſioned by its being made red-hot, and afterwards thrown into the water; for had it been ſo, the diamond would have been ſeparated into a great many particles, or one would have diſcovered ſeveral cracks or flaws therein. M. *Leewenhoeck*, viewing ſome ſmall ſtones (which a certain Goldſmith bought for diamonds, and which ſeveral people would have taken for precious ſtones) preſently judged them not to be diamonds; for they had neither ſharp points, nor ſmooth ſides, but appeared like tranſparent particles of ſand, whoſe angles, or points were worn off; and upon making theſe ſtones red-hot, and afterwards throwing them into water, he obſerved thro' his microſcope, that they had got a great many rents, or cracks; inſomuch, that with a little ſqueeſing they would crumble all to-pieces.

Fig. 4. S T V W X Y repreſents the ſmall particle of a diamond, no bigger to the naked eye than a ſmall grain of ſand; whence one may alſo judge of the largeneſs of the other diamond particles, repreſented by the preceding figures; this laſt mentioned particle was not put into the fire; at S T V W and Y the ſharp points of the ſaid particle may be ſeen. Whence M. *Leewenhoeck* concluded, that he was right in his former remarks concerning the particles of ſand; *viz.* that the ſaid very ſmall particles, conſiſting of regular points, and ſmooth ſides like diamonds, were ſoft at their firſt coagulation; but grew larger by the acceſſion of new matter, till they became large grains of ſand; and moreover, that ſome diamonds were formed juſt after the ſame manner: Now, as we find, that in the ſolution of ſilver by *Aqua fortis*, ſome of the ſmall ſilver particles are coagulated into chryſtals of the figure of diamonds, and that the ſugar which is boiled to a ſyrup, in order to make ſugar-candy, is alſo coagulated into ſuch particles; ſo we may likewiſe ſuppoſe, that at the time the diamond particles coagulate, a great deal of the ſame matter, whereof they are compoſed, is in the air, but not to be perceived by the naked eye, nor the quantity thereof to be known, till it is coagulated into a body; and who knows, but if a ſhovel full of that earth, out of which they dig diamonds, were brought over, and carefully examined by a microſcope, one might diſcover a great many exact and compleat little diamonds of an exceeding ſmallneſs: A great many people are of opinion, that ſeveral things lying in the bowels of the earth, and eſpecially diamonds, have a kind of growth, and that their increaſe is occaſioned by ſubterraneous fires, whereby the damps

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are ſublimed, which, they ſay, are impregnated with mineral, cryſtalline, or adamantine particles: But M. *Leewenhoeck* is not of that opinion; for if it were true, that an adamantine matter were produced by the ſubterraneous fires ſubliming the damps, we muſt conclude, that that matter would be fluid; and then, that that fluid matter thus ſublimed, would coagulate with the diamonds it met with in its way, and make them larger; but if that were true, this adamantine matter could not diſperſe the earth or ſand, with which the diamonds were ſurrounded, in order to its own accretion or coalition therewith; but this coagulating adamantine matter would involve earth, ſand, or whatever other particles lay in its way, by which means there would be no ſuch thing as a clear and clean diamond dug out of the earth: It is true, there is an earthy matter in and about ſome rough diamonds; but that may happen, as he ſuppoſes, in the very coagulation of the diamonds, and when their parts are ſoft: Amongſt ſeveral hexangular pieces of rock-cryſtal, he obſerved ſome whoſe ſides appeared very ſmooth to the naked eye, and whoſe points did not at all reſemble cryſtal, but rather a dark earth, which he ſuppoſes to be only occaſioned by the neighbouring earth's inſinuating itſelf into the parts of the ſaid cryſtal, at its firſt coagulation, and when it was ſoft.

Let us now ſuppoſe a diamond lying in the earth, and growing continually larger, whoſe axis is $\frac{1}{4}$ of an inch, or 150 hairs breadth, and that ſuch a diamond in the ſpace of 10 years was ſo much increaſed, that its axis, or the bigneſs of its body, was augmented on every ſide half a hair's breadth, and ſo proportionably every 10 years; conſequently, in the ſpace of 3000 years, its axis would be 300 hairs breadth larger, by which means the diamond would be 27 times bigger than at firſt: Now, if we ſuppoſe that a diamond in the ſpace of 10 years increaſes on all ſides a hair's breadth, its axis would be two hair's breadth, which in 3000 years would be 750 hairs breadth; and then the laſt mentioned diamond would be 125 times bigger than the diamond, whoſe axis was 150 hairs breadth; now ſuppoſing a diamond, whoſe axis was 150 hairs breadth, and its weight ſeven carats, what a prodigious diamond would that be, whoſe axis is 750 hairs breadth; and where ſhall we find ſuch a diamond?

An

An Account of a Child's *crying in the* Womb, *with a Dissertation thereon; by Mr.* Derham. Phil. Tranſ. N° 324. p. 485.

ONE *Clark* in the pariſh of *Horn-church*, was delivered of a child, that cried in her womb, at times, for near five weeks; it appeared to be luſty and ſtrong, and was after its birth a very quiet child; the firſt time the child cried was in the night-time, as the mother lay in bed, after a great pain which obliged her to get up, and gave her apprehenſions of her labour being nearer than ſhe imagined; and ever after, when the child cried, and during its crying, ſhe had violent pains like thoſe of labour: All the time it cried, it was cloſely confined and pent up on the left ſide of the mother's belly; ſcarcely a day paſſed in all the five weeks, but it cried more or leſs; but ſhe obſerved, that every other day it cried moſt, and that moſt certainly; the midwife informed Mr. *Derham*, ſhe heard it cry 17 times in half an hour; and its crying might be heard in the next room, and ſometimes it ſeemed to be ſo hearty, that the child would ſob again; both the midwife and mother told Mr. *Derham* that they found no great difference between her caſe, and that of other women in the ſame condition; upon aſking the woman whether ſhe had received any fall, or hurt, or was troubled with longings? She told him ſhe had received no hurt, but was more inclined to longing, but had what ſhe longed for.

Among the authors that queſtion the fact of the *Vagitus uterinus*, two of the moſt conſiderable are *Etmuller* and *Diemerbroeck*; *Etmuller* declares *Diemerbroeck*'s opinion as well as his own, in his *Diſſertation de abſtruſo reſpirationis humanæ negotio*, cap. 9. where he treats of Dr. *Harvey*'s problem; *viz.* 'Why the *Fœtus* after delivery, and before it has breathed, can 'live for ſome hours in the ſecundines, &c. but having once 'breathed, it can ſcarcely live a moment in that manner? *Etmuller*'s words are to the following purpoſe; 'Some take the '*Vagitus uterinus* to be an invincible argument for the reſpiration 'of the *Fœtus* in the *Uterus*; but ſince the teſtimony of ſilly 'women, who are generally the evidences in ſuch caſes, is not much 'to be regarded, and that the obſervation is not ſo accurately 'made, as to ſerve for a foundation for reſolving this problem, I 'juſtly ſuſpect with *Diemerbroeck*, that this crying, if any ſuch 'has ever been certainly obſerved, proceeds from the croaking of 'the flatulent guts compreſſed by the *Fœtus*, and which is often 'very ſurpriſing in ſome perſons, imitating ſighs and groans; and

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'the like I hold of, the peeping of chickens in the egg; especially 'as it has been found, that a thin watry vapour by striking against 'slender bodies, causes a hissing noise, as the illustrious Mr. *Boyle* 'shews by experiment.'

The matter of fact being thus called in question, Mr. *Derham* thinks that the present case may serve as a sufficient answer; and tho' he was as much inclined as any man, to doubt of the fact, being entirely of opinion, that the *Fœtus* does not live in the womb by breathing, yet the evidence was so clear in the present case, that he was fully satisfied it was really the crying of the *Fœtus*, and not the croaking of the guts, or *Uterus*, or the effect of any feminine imagination; for 1. Here we have a thing happening not once or twice only, but a great many times, almost every day, and at divers times in the day, and that for near five weeks together. 2. The child was heard to cry aloud, so as to be distinctly heard by persons in another room; consequently the hearers could more easily and certainly distinguish, whether the noise was crying or croaking; and the description the mother and others gave thereof, was; *That the noise the child made, was as if a born-infant had cried eagarly, shut close up in a tub.* 3. The crying seemed to be so eager, and hearty, as to terminate in sobbing, like what is oftentimes observable in born-infants. 4. It was heard not by the father and mother only, or by one or two besides, but by several, or most of the neighbourhood, both near and far off, and many of them persons long used to children; who all with the greatest assurance, affirmed that it was as plain crying, as ever they heard from a born infant, and nothing like any noise of wind, or of the guts. And in the last place, the midwife told Mr. *Derham*, that laying her hand on the left side of the woman's belly, where the child lay, when it cried, she could plainly feel a motion under her hand, like that of respiration, every blast of the child's crying sensibly affecting her hand: These particulars being considered, do not only prove the reality of the thing, but shew the case to be very considerable: Mr. *Derham* met with with several instances of this nature in divers authors, but none of so long continuance, and in which there were such frequent reiterations of the crying: The learned *Verzascha*, of *Basil*, gives a good catalogue of cases of this nature, in his third *Observ. Medic.* some of the best attested, of which, Mr. *Derham* recounts; and first, *Ant. Deusingius* in his *Dissert. de Generat. Fœtus*, tells us, says *Verzascha*, 'that he 'had it from his Collegue *Monæus*, that the child cried in his 'wife's womb, and the same thing happened to the wives of 'M. *Sal-*

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M. *Salmuth* and M. *Grænwolt*;' the next relation he gives is that of our Dr. *Needham*, of the *Fœtus* crying in the womb of an *Engliſh* woman of quality, as ſhe, her husband, and chaplain were together at ſupper; vide Dr. *Needham*'s book *De formato Fœtu*; the laſt inſtance is of *Chriſtian* II. king of *Denmark*, who was heard to cry before he was born: Now, theſe being caſes atteſted by perſons that may be ſuppoſed to be of better underſtanding than the fanciful vulgar, ſeem to claim ſomewhat more credit, the latter being the caſe of a king, and in all probability heard by ſome of the beſt quality about the court; the next heard by the chaplain, as well as by perſons of quality, and that three times ſucceſſively; and the former caſe coming within the cogniſance of gentlemen, and they probably men of learning too: Upon this whole evidence (and more Mr. *Derham* could have added, even from the time of *Hippocrates*) he concludes, that the *Fœtus* does really cry ſometimes in the womb; tho', how this is performed is hard to account for, ſurely not without reſpiration; and therefore Mr. *Derham* was apt to think, that tho' the *Fœtus* does not ordinarily breathe in the womb, yet it is poſſible for it to have an occaſional temporary reſpiration there; but whether in ſuch reſpiration, any of the blood paſſes into the lungs, or whether it does not continue its circulation thro' the *Foramen ovale* only; or if any more than ordinary blood, ſhould by ſuch reſpiration get into the lungs, whether it may not with eaſe, and without inconveniency be diſcharged thence, during that ſtate of life the *Fœtus* leads in the womb; all theſe doubts Mr. *Derham* does not pretend to determine; but however, this much, which favours his opinion, may be obſerved in the ſea-calf, and ſuch other animals as have the *Foramen ovale*, that the circulation of their blood is continued, notwithſtanding the diſcontinuance of their reſpiration for a long time.

As to the peeping of chickens in the egg, about which *Etmuller* has the ſame doubt as of the *Vagitis uterinus*, Mr. *Derham* himſelf heard it divers times, both from chickens and ducks; and he was aſſured by a perſon converſant in ſuch matters, that a little before the hatching, ſhe had often, and could at any time cauſe ſome chickens and ducklings to peep in the egg; ſhe affirm'd that ſometimes whole neſts of eggs would yield a peeping, and ſometimes only ſome particular eggs; but that ſuch eggs as have once peeped, may be made to peep, and cry, at any time, by ſhaking the egg, and putting the youngling into diſorder; and ſometimes where there has not been any noiſe heard before, the chick has been made to cry, by ſhaking the egg, wherein it was inclo-

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incloſed: The cauſe of this peeping in the ſhell, Mr. *Derham* takes to be owing to ſome uneaſineſs the young bird may feel therein; for being arrived to its perfect ſtate in the egg, it is either weary of its confinement, and deſires more liberty; or elſe it lies uneaſy, or is offended with ſhaking, and therefore, it peeps and cries, even as it does when uneaſy out of the ſhell; and after ſome ſuch manner Mr. *Derham* takes the caſe to be with a human *Fœtus*; viz. that it is in ſome diſorder, and uneaſy in the womb, and therefore cries as well in, as out of it; thus, he is apt to think was the caſe of the *Fœtus* above-mentioned, *viz.* that it lay very uneaſy in the womb all the while it cried there; perhaps alſo the *Fœtus* might find ſome uneaſineſs from a bone the midwife told Mr. *Derham* ſhe found ſtick out ſomewhat farther than ordinary, which upon examination, he takes to be one of the *Vertebræ* of the back; and if this bone cauſed any uneaſineſs to the *Fœtus*, it might alſo by that means poſſibly occaſion the mother's pains abovementioned.

Obſervations on the Edges of Razors, *by M.* Leewenhoeck. Phil. Tranſ. N° 324. p. 493.

M. *Leewenhoeck*, after ſetting a razor on an oil-ſtone, or hone, by paſſing it only once on one ſide, and that very gently, with the edge againſt the ſtone, and then on the other ſide in the ſame manner, and ſo for about 10 or 12 times, and afterwards paſſing it with its back downwards, on a leather prepared with tripoly, which ſilverſmiths uſe to poliſh or clean their plate with, viewed this razor thro' his microſcope, and he was ſurpriſed at the great number of gaps and notches he obſerved in its edge, and how one could ſhave ſo ſoftly therewith; M. *Leewenhoeck* owns, that in winter, and cold weather, ſhaving is a little more painful; but this at firſt he ſuppoſed owing to the hair of the beard being harder in winter than in ſummer; as to the razor's becoming blunt in cold weather, he now ſuppoſes, that the *Materia ſubtilis*, or the exceeding ſubtile matter, which is in all metals, and which we may compare to fire, is by the cold driven out of the edge of the razor, by which means the ſteel becomes ſo ſtubborn or hard, that the hair blunts and makes notches therein; he alſo found, that after ſhaving the beard with a fine razor, and attempting to cut ſome of the little hairs in the eye-brows, which were harder than thoſe of the chin, notwithſtanding they were ſoftened a little with water, ſeveral notches were thereby made in the ſaid razor: M. *Leewenhoeck* was told by a ſkilful barber, that when it was very cold weather, he always dip-

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dipped his razors in warm water, which made them cut much better.

The method M. *Leewenhoeck* uſed to prepare the leather, on which he paſſed his razor, was as follows; *viz.* having procured a piece of leather, very ſmooth on the fleſh-ſide, and about two inches broad, he glued it to a thin board of the ſame breadth; and when it was dry, he ſmeared it all over with a tallow-candle, and then he held it a little over the fire, till the greaſe had inſinuated itſelf into the pores of the leather, and this he repeated three times; afterwards, he poured over it a little tripoly, waſhed clean, which with the greaſe he worked into the leather ſo long, till the greaſe became warm; then he poured on freſh tripoly, repeating that operation four or five times, till his ſmoothing-leather was fit for uſe: He has alſo taken fine powdered emery (a powder, or ſtone, which is likewiſe uſed by ſilverſmiths to poliſh their plate) which he firſt ſteeped in a little water, and then he poured a good deal more upon it; and ſtirring them well together, he afterwards let them ſtand a while, and poured off the uppermoſt part of the water, impregnated with the fine emery into another glaſs; and after that, he put a little linen or woollen rag into the aforeſaid water, one end of which reached to the bottom of the ſaid emery, which he ſuppoſed to remain in the glaſs, and the other hung out, in order to draw off all the water from the ſubſided emery; which being thereby become dry, he rubbed into the greaſed leather, in the ſame manner as before he had done the tripoly; only with this difference, that he worked in the emery with a piece of ſmooth ivory, or elſe with a burniſhing ſteel; after this, he ſtroaked his razor ſoftly over it, and the effect was, that razors with which before he had cut wood, and which he had thrown aſide as uſeleſs, were now recovered to ſuch a degree, as to be fit to ſhave one's beard again.

The abovementioned barber had a razor, which tho' it appear'd very fair to the eye, yet was ſo ſtiff, that by paſſing it ever ſo often on a hone, and ſetting it upwards of 50 times he could not bring it to bear; M. *Leewenhoeck*, viewing this razor thro' his microſcope, obſerved ſeveral notches therein, whereupon paſſing it over his ſtrop or ſmoothing leather, prepared with fine emery, and afterwards uſing it, it was found to be very good: Now, as one razor is ſofter than another, M. *Leewenhoeck* adviſes to paſs a ſoft razor on a ſtrop, prepared with tripoly, and a hard one upon a ſtrop prepared with emery.

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As to the fine particles of ſteel, of which the edge of a razor conſiſts, as alſo thoſe of gold, ſilver, *&c.* they are inconceivably ſmall; one may indeed with a good microſcope, juſt diſcover the exceeding ſmall particles of gold and ſilver, but cannot diſcover their figure; and who can determine the vaſt number of parts of which thoſe ſmall particles, which we obſerve with a microſcope, are again compoſed; and tho' we can diſcover thoſe ſmall particles, of which gold and ſilver conſiſt, becauſe we can diſſolve both gold and ſilver in proper *Menſtrua*, and unite them therewith, and again collect thoſe particles of gold and ſilver together, fit for our view; yet this has no place in iron, or ſteel, whoſe fine particles we can only diſcover, for inſtance, in the gaps, or notches of a razor; and the bigger and coarſer the particles are, of which thoſe metals conſiſt, as we may ſee in caſt iron, the leſs valuable they are; but the finer the particles are, the more valuable will be the ſteel and iron which they compoſe: Now, when we view the ſmall broken particles of gold, ſilver, ſteel, iron, *&c.* We muſt conſider each of thoſe particles, as ſmall as they appear to us, to be again compoſed of a great many other exceeding ſmaller particles, which nature has united together; and that theſe coagulated particles are ſtill more ſtrongly united by fire, and afterwards conſolidated by the ſtrokes and preſſure of the workman's hammer, in ſuch a manner, that they ſeem to us to be but one body, tho' they conſiſt of a great many ſmall particles, the coarſeſt of which are always obvious, when we come to break the metals; and how often ſoever you melt any of theſe metals, and break them again, after they are cold, you will always be able to diſcover the grainy particles thereof; but you will find them ſo ſtrongly joined, and rivetted in each other, that they appear to be but one body: When the ſteel is prepared, and made into a razor, and ſet upon a hone, we may perceive a great many long ſtreaks, or ſcratches of the ſaid ſtone upon the razor; and the coarſer the ſtone is, the coarſer and deeper thoſe ſtreaks are in the ſteel; they paſs the razor thus prepared upon one ſtone, oftentimes upon a finer, in order to grind out the aforeſaid long ſtreaks, which it had acquired upon the coarſe ſtone; for every one of ſuch ſtreaks in the ſteel, when it is ſharpened or ground again, becomes a notch; when ſuch notches are ground out of the razor on a fine oil ſtone, or hone, the ſteel, where any of theſe notches were, appears to the eye, as ſmooth as glaſs; but when we come to view the razor with one of our beſt microſcopes, we may diſcover that thoſe long ſtreaks, which cauſe the notches, are no more taken away by

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by the oil ſtone, than when the razor is ground on a rough ſtone; the only difference is, that the ſtreaks of the former are firmer than thoſe of the latter; in ſhort, when one obſerves with a good microſcope the ſeveral notches in the fineſt razor, it is ſurpriſing, how any of them could cut ſo well.

M. *Leewenhoeck* viewed ſeveral times with a microſcope the hairs of his chin, after they were cut off, and he always obſerved upon the white, or grey hairs, the ſtreaks which are made by the ſmall notches, which as he obſerved before, he had diſcovered in his razor, eſpecially, when thoſe hairs were cut more obliquely than uſual; for in ſuch hairs he has often ſeen above 12 ſtreaks, occaſioned by ſo many notches in the razor, all within the compaſs of a hair's breadth, and which was alſo obſerved by another gentleman: Amongſt ſome of thoſe ſmall hairs M. *Leewenhoeck* diſcovered ſeveral, whoſe roots were entire, but he could not perceive that they had been touched by the razor; this at firſt ſeemed ſtrange to him, becauſe he had always imagined, that the hair of the head and face did not change, or fall off, like that of other parts of the body; but he conſidered, how much the ſkin is ſoftened by warm water, and hard rubbing, and that the notches in the razor, which by reaſon of their ſmallneſs, eſcape the naked eye, when they meet with ſuch hairs, cannot cut them off, but rather tear them out by the roots; which likewiſe may be the cauſe of the pain, or ſmart, that one feels, when ſhav'd with an indifferent razor; he viewed ſome of thoſe ſmall hairs, that had the roots on, and he obſerved that their ſides were tore, or mangled a little, which he ſuppoſes might be occaſioned by the notch of the razor, that had laid hold of the hair in that part, and ſo pull'd it out: Moreover, M. *Leewenhoeck* obſerved the muſcles of a cod-fiſh, and found that none of the ſmall particles, of which the ſaid muſcles conſiſt, were thicker than the ſingle hair of a man's chin, but they were of ſeveral ſizes, ſome not half ſo big as others; when the parts of the fiſh were dry, he cut ſome of theſe muſcles a-croſs, with a razor, which he ſet, and prepared in the manner above-mentioned; and he obſerved in ſome of thoſe muſcles ſo cut, as many ſmall ſtreaks, as there were notches (inviſible indeed, to the naked eye) in the aforeſaid razor; and as every particle of the muſcle of the ſaid fiſh conſiſts of a vaſt many long ſlender particles, ſo every little notch of the razor did not only make a little ſtreak in the muſcle, to which it was applied, but alſo cauſed ſuch a roughneſs therein, that a perſon might diſcover the exceeding ſlender particles, of which one of the long particles, no

thicker than a coarſe hair, is compoſed, tho' the ſmall long particles dried up ſo quick, that one would have taken them for a ſolid body: For his further ſatisfaction, M. *Leewenhoeck* having viewed thro' a microſcope the grey hairs, ſhaved off the chin of a perſon of 50 years of age, diſcovered the ſtreaks, the razor had made therein, as plainly as thoſe he mentioned before, tho' the ſaid perſon told him, he had not been ſhaved for a long time, ſo ſoftly and eaſily as he was then; among theſe hairs he obſerved a great many ſmall ones, whoſe roots were compleat, and amongſt ſeveral of different figures, he obſerved one hair, that had three ſides with roundiſh angles, and that all the three ſides bended inwards: He likewiſe obſerved the hairs of the beard of another perſon, about 60 years of age, in which he diſcovered the little ſtreaks, occaſioned by the notches of another razor, but with this difference, that the ſtreaks in the laſt hair were finer than thoſe in the former, which M. *Leewenhoeck* only attributed to the laſt razor, being ſet upon a finer hone; and amongſt theſe hairs he alſo found ſome that had their compleat roots.

Microſcopical Obſervations on the cryſtaliz'd particles of Silver, *diſſolv'd in* Aqua fortis; *by M.* Leewenhoeck Phil. Tranſ. N°. 325. p. 20.

AFTER M. *Leewenhoeck* had examined the coagulation of thoſe particles he found in *Aqua fortis*, impregnated with ſilver, and ſhewn that they had aſſumed the figure of ſo many rough diamonds, he ſeparated the ſilver, and melted it, and then poured freſh *Aqua fortis* thereon, to the end he might once more diſcover its cryſtalline, or adamantine figures, but to no purpoſe; for he could only now and then meet with a ſingle cryſtalline figure of the ſhape of a diamond: For his farther ſatisfaction M. *Leewenhoeck* took a piece of ſilver, part of a piece of eight of *Portugueſe* coin, and threw it into *Aqua fortis*, where it had not lain long before the water was tinged with a green colour, whence he inferred there was a great deal of copper therein; after this ſilver had lain 11 days in the *Aqua fortis*, he ſaw with his microſcope a great many oblong particles coagulated therein, which he judged to be hexangular, and as clear as cryſtal; he poured off this water as gently as poſſible, that the ſaid particles might remain behind in the glaſs, and afterwards he poured upon them four times as much rain-water, as there had been *Aqua fortis* at firſt, that the ſalt particles, that were ſtill in the glaſs, might diſſolve therein; then he drew off this water again, and poured freſh water thereon, and afterwards viewing the

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the above-mentioned particles thro' his microſcope, he obſerved them in great numbers ſticking to the ſides of the glaſs; but he found that thoſe which had been as clear as cryſtal before, had now loſt a great deal of their tranſparency, and aſſumed a pale red colour, which from time to time grew redder, and after ſome hours the colour was ſo deep, that it appeared blackiſh, having no manner of tranſparency, and where the particles lay thick together, they appeared to the naked eye like a whitiſh matter; he likewiſe poured off very gently the *Aqua fortis* from another glaſs, wherein were a great many of theſe long cryſtalline particles, and then turned the glaſs upſide down, that the little water which ſtill remained therein, might be drained out, by which means a great many of the ſaid particles remained ſticking to the ſides of the glaſs, and in regard he poured no rain water upon them they retained their tranſparency; and it is to be obſerved, that the above-mentioned coagulated particles were but a very ſmall part of the ſilver, thrown into the *Aqua fortis*: As often as M. *Leewenhoeck* diſſolved the ſilver in *Aqua fortis*, he could not diſcover any great number of diamond-like figures, but only ſeveral long particles, ſuch as are repreſented by Plate VI. Fig. 5, 6, 7, 8, 9; upon which he began to ſuſpect the goodneſs of his *Aqua fortis*, and therefore procured ſome of a goldſmith, and in this he diſſolved not only his own ſilver, but likewiſe ſome coined in *England*, and that proved to his ſatisfaction; for he diſcovered therein as many particles of the ſhape of bright diamonds, as in any of his foregoing obſervations, only with this difference, that the cryſtalline particles of the *Engliſh* ſilver were not ſo tranſparent as the other, and that the ſilver, which is ſuppoſed to be alloyed with $\frac{1}{12}$ part of copper, tinges the water with a very green colour, and leaves a great deal of droſs at bottom; he likewiſe obſerved, in the ſame water ſome few oblong cryſtalline particles, as above-mentioned, with ſix ſides, and terminating in two points of the ſame ſhape with particles of rock-cryſtal, only with this difference, that moſt of them had but one hexangular point, the reaſon of which he ſuppoſed to be, that the other end was faſtened to the rock; and as this appeared ſtrange to him, he examined again ſome of thoſe diamond cryſtalline particles which lay by him, and diſcovered among them, but in a very ſmall quantity, ſome of the laſt mentioned figures, as repreſented by A B Fig. 10; and M. *Leewenhoeck* imagines, that all the mountain cryſtal would be of the ſame ſhape, if the rocks and ſtones, among which it is found, did not hinder, whilſt it is ſtill ſoft: He alſo obſerved one hex-

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angular figure, which only differed from the preceeding, in that one ſide thereof was at leaſt twice as broad as its oppoſite ſide, by which means the hexangular point ſtood a-ſkew, as in CDEF Fig. 11.

GHIK Fig. 12. repreſents another ſmall cryſtalline particle of the ſame ſhape with the former in its ſides, and at one extremity, as repreſented by I, but the other extremity G was not hexangular, but of the ſhape of a hatchet: In the middle of the ſame figure there appeared a break, or rent, which ſeemed to M. *Leewenhoeck* as if they had been two diſtinct particles, which were joined, as they grew, till they became one body, and ſtill there remained the marks of their joining, as may be ſeen between H and K.

An Account of Spiders *and their* Silk; *by M.* Bon. Phil. Tranſ. N° 325. p. 20.

SPIDERS make a ſilk as beautiful, ſtrong and gloſſy, as common ſilk; the prejudice, entertained againſt ſo common and deſpicable an animal, is the reaſon that the public has been hitherto ignorant of the uſefulneſs thereof: Common ſilk, as conſiderable as it is, lay long unknown, and neglected after its diſcovery; it was in the iſland of *Cous*, that *Pamphila* daughter of *Platis*, firſt diſcovered the manner of working it, *Ariſtot. Hiſt. Animal. lib.* 5. *cap.* 19: This diſcovery became ſoon after known to the *Romans*, who brought their ſilk from the country of the *Seres*, a people of *Scythia* in *Aſia* near the mountain *Imaus*, where ſilk-worms naturally breed, *Plin. Hiſt. Nat. lib.* 6. *cap.* 17. & *lib.* 16. *cap.* 17. *Iſidor. Orig. lib.* 19. *cap.* 23. But far from making any advantage of ſo uſeful a diſcovery, they could never imagine that theſe worms ſhould produce ſo beautiful and valuable a thread, and formed a thouſand chimerical conjectures about it; ſo that their ignorance and lazineſs together made ſilk for ſeveral ages ſo extraordinary ſcarce and valuable, that it was ſold for its weight in gold; and *Vopiſcus* relates, that for this reaſon the emperor *Aurelian* refuſed his empreſs a ſuit of ſilks, tho' ſhe earneſtly deſired it; its ſcarcity continued a long time; and it is to the monks we owe the manner of breeding ſilk worms, who brought their eggs from *Greece*, under the reign of the emperor *Juſtinian*, as we learn from *Godefridus* in his notes on the *Code*; and *Ulpian* aſſures us, that the price of ſilk was equal to that of pearls: It was late before *France* made any advantage of this diſcovery; *Henry* II. brought to the marriages of his daughter and ſiſter the firſt ſilk ſtock-

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inge that were ſeen in his kingdom, *Mezeray Hiſt. T. 3. p. 1254. Edit. Paris.* To him and his ſucceſſors it is that *France* owes the eſtabliſhment of this manufacture at *Tours* and *Lions*, which has made ſilk ſo common, and ſo greatly increaſed the magnificence of furniture and cloaths. Hence it appears of what importance it is in the ſtudy of nature not to overlook any the ſmalleſt thing; what at firſt ſeems of no uſe, or almoſt impoſſible to be put in execution, oftentimes turns to the greateſt advantage, and becomes eaſy by care and induſtry. The ingenious fable of *Arachne* ſhews, that it is to the ſpider we owe the firſt hints of weaving cloth and laying nets for animals, *Plin. Hiſt. Nat. lib. 7. cap. 56.*

M. *Bon* reduces all the different ſpecies of ſpiders to two principal kinds; *viz.* ſuch as have long legs, and ſuch as have ſhort ones; it is this latter that furniſhes the ſilk; in particular they are diſtinguiſhed by their colour, ſome being black, others brown, yellow, green, white, and ſome again of all theſe colours mixed together; they likewiſe differ in the number, and poſition of their eyes, ſome having 6, others 8, and ſome 10, differently placed on the top of the head, as may eaſily be ſeen by the naked eye, but much better thro' a glaſs; they are alike in other reſpects, as in their body, which nature has divided into two parts; the fore-part is covered with a ſhell, or hard ſcale beſet with hairs; it contains the head, and breaſt, to which are fixed its eight legs, each conſiſting of ſix joints; they have alſo two other legs which may be called their arms, and claws, armed with two crooked nails, and joined by articulations to the extremity of the head; with theſe claws they kill the inſects they feed on, their mouth being immediately beneath them; they have likewiſe two ſmall nails at the end of each leg, and a ſpongy ſubſtance between them, which undoubtedly, is of ſervice to them, when they go upon ſmooth bodies: The hinder part of the body of this inſect is joined to the fore-part, only by a ſmall thread, and covered with a thin ſkin, on which are hairs of divers colours; it contains the back, belly, parts of generation, and the *Anus*: It is certain, that all ſpiders ſpin their thread from the *Anus*, about which there are five *Papillæ*, or ſmall nipples, which at firſt ſight one would take for ſo many ſpindles, that ſerve to form the thread; M. *Bon* found theſe *Papillæ* to be muſcular, and furniſhed with a ſphincter; a little within theſe he obſerved two others, from the middle of which iſſue ſeveral threads, in a pretty large quantity, ſometimes more and ſometimes leſs, which the ſpiders make uſe of in a very artful manner, when they have a mind

a mind to go from one place to another; they hang perpendicularly by a thread, and turning their heads towards the wind, they ſhoot ſeveral others from their *Anus*, like ſo many darts; and if by chance, the wind which ſpreads them abroad, faſtens them to any ſolid body (which they perceive, by the reſiſtance they find, in drawing them in, from time to time with their feet) they then make uſe of this kind of bridge, to paſs to the place where their threads are fixed; but if theſe threads meet with nothing to fix on, the ſpiders continue to let them out farther, till their great length and the force with which the wind drives them, ſurpaſſing the weight of their bodies, they find themſelves ſtrongly drawn; and then breaking the firſt thread, which they hung by, they let themſelves looſe to be driven by the wind, and flutter on their backs in the air, with their legs extended, and by theſe two methods it is, that they paſs over roads, ſtreets and the broadeſt rivers: One may wind up theſe threads, which by reaſon of their being united together, ſeem to be but a ſingle thread, when about a foot long, but M. *Bon* has diſtinguiſhed them into 15 or 20, at their iſſuing from the *Anus*; what is further remarkable, is the eaſe with which this inſect moves its *Anus* every way, by means of the ſeveral rings that border upon it; this is abſolutely neceſſary for them, in order to wind up their threads, or ſilk, which in the female ſpider, is of two ſorts; however M. *Bon* believes, that this inſect is androginous or hermaphrodite, having always found the ſigns of a male in ſuch ſpiders as lay eggs: The firſt thread that they wind is weak, and ſerves them for no other uſe, than to make that ſort of web, in which they catch flies; the ſecond is much ſtronger than the firſt, in this they wrap up their eggs, and by this means preſerve them from cold, and ſecure them from ſuch inſects as would deſtroy them; theſe laſt threads are wrapp'd up very looſely about their eggs, and reſemble in ſhape the bags of ſilk-worms, that have been prepared and looſened between the fingers, in order to be put upon the diſtaff; theſe ſpider-bags, if they may be ſo called, are of a grey colour, when new, but turn blackiſh, when long expoſed to the air; it is true one may find ſeveral other ſpider bags of different colours, and that afford a better ſilk, eſpecially thoſe of the *Tarantula*, but this ſort is very ſcarce: The ſhort-legged ſpiders, which are the moſt common, always find out ſome place, ſecure from the wind and the rain, to make their bags in, as hollow trees, the corners of windows, or vaults, or under the eaves of houſes; and by getting together a great many of theſe bags, M. *Bon* made this new ſilk, which is no ways inferior in beauty to common ſilk; it eaſily takes all ſorts of

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of colours, and of it he made ſtockings and gloves: The manner of M. *Bon*'s preparing the bags to make the ſilk, is as follows.

After he had got together 12 or 13 ounces of theſe ſpider-bags, he beat them well for ſome time with the hand, and a ſmall ſtick to free them from duſt; then he waſhed them in warm water, till the water that came from them was clear; afterwards he let them ſteep in a large pot, with ſoap, ſaltpetre, and ſome pieces of gum arabic, and let the whole boil for two or three hours over a gentle fire; then he waſhed them again with warm water, to free them from the ſoap, and letting them dry for ſome days, he looſened them a little between the fingers, that they might be more eaſily carded by the common ſilk-carders, only that he cauſed them to uſe much finer cards; by this means he had a ſilk of a very particular aſh-colour, which is eaſy to be ſpun, and yields a thread much ſtronger and finer, than that of common ſilk; which ſhews, that all ſorts of work may be made thereof: Thus the uſefulneſs and poſſibility of making this ſilk being ſhewn, the only difficulty is to procure a ſufficient quantity of ſpider's bags; and this would be no difficult matter, if we could breed ſpiders as they do ſilk-worms; for they multiply much more, and every ſpider lays 6 or 700 eggs; whereas the *Papilio*'s or flies of ſilk-worms, lay but 100, or thereabouts; and of this number we muſt abate half at leaſt, on account of their being ſubject to ſeveral diſeaſes, and being ſo tender, that the leaſt matter hinders them from making their bags; whereas on the contrary, the eggs of ſpiders hatch of themſelves, without any care in the months of *Auguſt* and *September*, in 15 or 16 days after they are laid, and the ſpiders that laid them die ſometime after; as for the young ſpiders that are bred from theſe eggs, they live for 10 or 11 months without eating and continue in their bags without becoming either bigger, or leſs, till the hot weather obliges them to come forth, in ſearch of food, the reaſon of this is plain and natural; for all inſects, and a great many other animals, as bears, ſerpents, mountain-rats, *&c.* that lie hid during the winter, abound with a viſcid matter, which is not eaſily put into motion; ſo that it is not ſurpriſing, that young ſpiders ſhould live in the cold weather, upon their own ſubſtance, without any loſs of ſpirits; but as ſoon as the warm weather comes on, it puts this matter into motion, and obliges them to ſpin, and run from place to place in queſt of food; and as ſoon as they begin to eat, one may perceive them grow bigger and bigger every day; whence we may certainly conclude, that if we could find out a way of breeding young ſpiders in rooms, they would furniſh us with a much greater quantity of bags, than ſilk-

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ſilk-worms do; for M. *Bon* has always found, that of 7 or 800 young ſpiders, there ſcarcely died one in the year; and on the contrary, of 100 young ſilk-worms, not 40 lived to make their bags. In order to procure a large quantity of theſe bags, M. *Bon* made uſe of the following expedient: Having ſhut up in papers all the large ſhort-legged ſpiders that could be found in *August* and *September*, he put them into pots, and covered the pots with a paper pricked full of holes, with a pin, as were likewiſe the ſeveral papers that were in it, that the ſpiders might have air; he fed them with flies, and ſometime after he found, that the greateſt part of them had made their bags; but he more eaſily procured a large quantity of them, by promiſing to pay the ſame price for them, as for common ſilk; and the people who gather'd them aſſured M. *Bon*, that they found no difficulty in getting them, and that if they were permitted to go into every houſe, where they ſaw theſe ſpider bags in the windows, they could furniſh him with what he pleaſed; ſo that we may eaſily conclude that there are ſpiders bags enough to make large pieces of work, and that this new ſilk, which he propoſes, is not ſo ſcarce, or dear as common ſilk was at firſt; and ſo much the more, becauſe ſpiders bags, in reſpect of their lightneſs, yield much more ſilk than the others; for 13 ounces yield near four ounces of clean ſilk, three ounces of which will make a pair of ſtockings for the largeſt ſized man; the ſtockings which M. *Bon* had made, weighed but two ounces and $\frac{1}{4}$, and the gloves about $\frac{1}{4}$ of an ounce; whereas ſtockings of common ſilk weigh ſeven or eight ounces.

M. *Bon* is perſuaded, that a great advantage might be made of this inſect, which has always been looked on both as troubleſome and dangerous, on account of its poiſon; but he aſſures, that they are not venemous, having been very often bit by them, without any bad conſequence; and as to their ſilk, it is ſo far from having any venom, that every body makes uſe of it to ſtop bleeding, and heal cuts; and indeed its natural gluten is a kind of balſam, that cures ſmall wounds by defending them from the air: Their ſilk is uſeful, not only in reſpect of the manufacture it produces; but more ſo on account of the ſpecific medicines, that may be extracted from it; by diſtillation it yields a large quantity of ſpirit, and volatile ſalt; and by comparing he found, that it yields, at leaſt, as much as common ſilk, which of all mixed bodies yields the moſt; this ſalt and volatile ſpirit, extracted from ſpiders bags, is very active, as may be judged by the following experiment; it changes the tincture of flowers of

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turnsole into a beautiful green emerald colour; it congeals and reduces to a sort of snow, the solution of corrosive sublimate; whereas, the volatile alcali's extracted from a human scull, hartshorn, and divers other mixed bodies, only render it white, or milky; so that this new alcali being prepared after the same manner, as that extracted from the bags of silk-worms in making the *English Drops*, so famous over all *Europe*, may serve to make other new drops, which may deservedly be called drops of *Montpellier*; and which we need not scruple to make use of with much greater success than the old ones, in apoplexies, lethargies, and all soporous diseases, by reason of their activity; and they are taken with less reluctance, as their smell is not so fetid and disagreeable.

Plate VI. Fig. 13. shews the belly of a spider, with the *Anus* and five *Papillæ*, from whence the threads issue.

Fig. 14. the side of the *Penis* of a spider, as magnified by a microscope.

Fig. 15. the fore-part of the *Penis* of a spider, as magnified by a microscope.

Fig. 16. the follicle or bag of a field-spider, with a harder shell, upon the breaking of which the young spiders come out mixed with the silk.

Fig. 17. the follicle or bag of a house-spider, with a softer shell, wherein the young ones are inclosed.

Fig. 18. a spider hanging on the branch of a tree, with its head turned against the wind, and spinning out its thread, till it finds that it adheres to some body (as to the wall here represented) by which kind of bridge it passes over rivers, &c.

Fig. 19. a spider, after having broken the first thread, by which it hung, and spun out several others, carried by the wind, and floating in the air with its legs extended.

An Observation of an Eclipse *of the* Moon, *compared with the Calculation; by Mr.* Cressener. Phil. Trans. N° 325. p. 16.

MR. *Cressener* found the end of the lunar eclipse, on *February* 2, 1709-10, to be almost the same with the calculation, according to Sir *Isaac Newton*'s theory, and the difference but very inconsiderable: Mr. *Cressener* has added the calculation from Mr. *Flamstead*'s tables, according to Mr. *Horrox*'s theory, as published in Mr. *Whiston*'s astronomical lectures, with the *Radix* of the mean motion, corrected according to their first author's later observations, which are the same with those

assum'd in Sir *Isaac Newton*'s theory: By comparing these two calculations, we may observe, that tho' most of the additional equations in Sir *Isaac Newton*'s theory be very small, in this situation of the moon; yet they all conspire in such a manner as to make her place considerably more agreeable to observation, than those of *Horrox*'s system: The observation was made at *Streatham*, about six miles nearly directly south of *London*, with a very good eight foot telescope; to correct the clock for want of an instrument, he carried with him next day two watches, that were before adjusted to the clock, and compared with Mr. *Flamstead*'s at the Royal Observatory, having first noted its error by an observation of the sun's transit of the meridian; upon his return, he found his watches still to agree together, and with his clock, which shewed that they went true, and gave him the precise error of his clock, and the true time at the observation.

Mr. *Flamstead* afterwards acquainted Mr. *Cressener*, that by his observation of the meridional transit of the *Lion's Heart*, during the eclipse, his clock required a yet farther correction of one minute, and which Mr. *Cressener* has here accounted for.

February. 1709-10.	D.	H.	M.	S.
The mean time of the mean opposition	2	4	9	42
The mean time of the true opposition	2	10	54	48
At which the true place of the sun is	10	24	55	50
And its equation to be added.				
The place of the moon at this time, from Sir *Isaac Newton*'s theory.	S.	D.	M.	S.
Mean motion of the moon	4	26	57	37
Annual equation subst.			8	34
The correct mean motion	4	26	49	03
Mean motion of Apog.	11	18	13	54
Annual equation of Apog. add.			14	33
Correct mean motion of Apog.	11	18	28	25
Second equation from the distance of Apog. from the sun add.			2	27
Place of the moon the second time equat.	4	26	52	00
Mean motion of the node	11	01	34	25
Equation of node substr.			06	54

Correct

	S.	H.	M.	S.
Correct mean motion of node	11	01	27	31
The third equation of the moon from node's aspect with the sun subst.				10
Place of the moon the third time equated	4	26	51	50
Second equation of Apog. subst.			7 45	41
The true place of Apog.	11	10	42	44
Mean anomaly	05	16	09	06
Equation of center subst.			1 53	31
Moon's place the fourth time equated	4	24	58	19
The variation add.				11
Moon's place the fifth time equated	4	24	58	30
The sixth equation from the distance of luminaries and Apog. add.			1	29
Moon's place the sixth time equated.	4	24	59	59
The seventh equation add.				34
True place of the moon in its orbit	4	25	00	24
True place of the sun	10	24	55	50
Moon beyond the opposition			4	34
Which divided by the horary motion of the moon from the sun gives			7	42

	D.	H.	M.	S.
The mean time therefore of opposition *Feb.*	2	10	47	06
And the true time	2	10	32	20

The place of the moon at the same time, from the tables in Mr. *Whiston*'s astronomy, according to Mr. *Horrox*'s theory.

	S.	D.	M.	S.
Mean motion of the moon	4	25	57	37
Physical parts subst.			8	21
Correct mean motion	4	26	49	16
Mean motion of Apog.	11	18	13	54
Equation of Apog. subst.		7	25	00
Mean Anomaly	5	16	00	22
Equation of the center subst.		1	53	53
Place of the moon in its orbit	4	24	55	23

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	S.	D.	M.	S.
Distance from the opposition				27
That is in time to be added				45½
	D.	H.		
Therefore the mean time of true opposition is exactly	2	10	55	55
The apparent time	2	10	40	42
	S.	D.		
Place of the moon in the ecliptic	4	24	57	27
Reduction between the true opposition and middle of the eclipse add.			2	47
	D.	H.		
Middle of eclipse	2	10	43	34
Continuance of eclipse		2	55	06
Digits eclipsed		9	55	00
Beginning of eclipse	2	9	16	01
End of eclipse		12	11	07
End of the eclipse by the moon's place from Sir *Isaac Newton*'s theory		12	02	00
End by observation		12	01	30
End by calculation from *Horrox*'s theory		12	11	08

Therefore the error of Sir *Isaac Newton*'s theory, is by this observation, but half a minute, or none at all; of *Horrox*'s system nine minutes and a half.

The Manner of making Microscopes; *by Dr.* Adams. Phil. Transf. N° 325. p. 24.

M. *Leewenhoeck*'s glasses (the particular examination of which was a favour he allowed to none) appear to Dr. *Adams*, to be spherules lodged between two plates of gold, or brass, in a hole whose diameter might not exceed that of a small pin's head, and the objects the Dr. saw thro' them were pretty and diverting; but still their make and truth are unknown: Mr. *Butterfield* is very curious in melting his glass, but the Dr. supposes, unsuccessful in casting his spheres; for besides that a sufficient quantity of beaten glass cannot stick to the moistened point of a fine needle, so neither can it run equally, hold the needle how you will, nor will the globule, when run, stick to the needle, but must unavoidably drop, and wheresoever it happens to fall, it must in that almost liquid state receive impressions, sufficient to spoil its sphericity: Mr. *Gray* has shewn the defect of his method, and which he used to recover by grinding and polishing his glasses, on a brass plane, and so reduce them to

to hemiſpherules; but how far ſhort poliſhed glaſſes, eſpecially ſmall ones, come of thoſe that are caſt, any one may judge, who has ſeen both; the Dr. never ſaw his water, and quickſilver microſcopes, and ſo could form no judgment of them: After what manner Mr. *Wilſon*'s glaſſes are made, the Dr. knows not, but ſure his greateſt magnifiers are ill placed, being ſunk to ſo great a diſtance from the eye, that the object cannot appear to that advantage, it otherwiſe would; if therefore, inſtead of a hollow cap, he would contrive a plane plate of any metal, for the reception of the glaſs, then the eye, and the object might come to their due diſtance; neither ought there to be any *Cake*, or glaſs between the object, and the ſpherule, when we uſe the greateſt magnifiers; becauſe if the *Focus* of a ſphere be upon the extremity of its circumference, any ſmall diſtance from that muſt ſpoil the appearance of the object: Dr. *Adams* could not ſay, that his own glaſſes were without any imperfection, but he thinks, that they magnify more than any he had ſeen; and were they placed to the beſt advantage, they would magnify much more than they do: They are made thus; he takes a piece of fine window glaſs, and raſes it with a diamond, into as many lengths as he thinks neceſſary, not exceeding an eighth of an inch in breadth, then holding one of theſe lengths between the fore-finger and thumb of each hand, over a very fine flame, till the glaſs begin to ſoften, he draws it out to a fine hair; then running each of the extremities into the pureſt part of the flame, he preſently obtains two ſpheres, which he can make larger, or ſmaller at pleaſure; if they continue long in the flame, they contract ſpots, ſo that he draws them out preſently after they become round; as for the ſtem he breaks it off, as near the ball as he can, and lodging the remainder of this ſtem between the plates, and drilling the hole exactly round, all this protuberance is buried between the plates, and the microſcope performs to admiration; inſomuch, that the ſame thread of very fine muſlin appeared three or four times bigger in one of theſe, than it did in the firſt or ſecond magnifiers of Mr. *Wilſon*'s; the Dr. imagined he ſaw animals in fine old brandy, but they were ſo nimble in their motion, that he could give no particular deſcription of them; human blood is ſo far from ſhewing any red globules ſwimming in *Serum*, that immediately after its emiſſion, it appears to be a body of a vaſt many branches, running in no certain order, and variouſly coloured; where it lay thickeſt on the glaſs, it was of a dull red, where thin inclining to yellow, but the whole blended in ſuch a manner, as very nearly to repreſent the top of a yew-tree,

in

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in a very fine landskip, having its supposed branches of a red and yellow colour, confusedly intermixed; but not satisfied with this appearance, tho' the same as to quality, in 11 different glasses, and as many different sorts of blood, he resolved to view it another way, which was, by diluting one third of thick, in the *Serum* of blood; and laying it upon his glass, he could see the red branches, as before, and the transparent part filled with particles of great variety of figures, which he took to be the salts of the blood, but very few were globular, and they were pellucid; if the fluids moving in an evanescent artery appear globular, he supposes it is, because the canal is round, which alters the case much: The Dr. had at the same time an opportunity of viewing some pleuritic blood, and he thought that its branches spread in a different manner from sound blood, and were more perplexed with cross branches, which appeared black, like blood, that had stood two or three days; whether the attraction of particles arising from this difference of figure, may not render the blood incapable of passing thro' the capillary arteries of the *Pleura*, in that case he leaves others to determine; but he should think that since the propelling force of the heart is least at the capillary arteries, that there the attractive force of the particles of the blood should be greatest; and since spherical bodies are the most attractive of any, respect being had to their solidities, were the blood so plentifully stocked with globules, as some affirm, we should never be free from obstructions, the natural consequence of this attractive force.

The Mischiefs arising from swallowing Plumb-stones; *by Dr.* Holbrooke *with Remarks thereon; by Dr.* Cole. Phil. Trans. N° 325. p. 28.

IN *September* 1700 one *Crumbleholm* came to Dr. *Holbrooke*, and complained of a great loss of appetite, with a scorbutic itch, and ever and anon severe convulsive colics below his navel, all along the *Hypogastrium*; they did not last above a quarter of an hour at a time, but often recurred, and raised tumours, of the bigness of a large walnut, which disappeared, and removed as the pain shifted; he had been troubled therewith some years, and took physic of almost every one he met with, but not in any regular method: Dr. *Holbrooke* began with mild, emollient, and carminative glisters, and purged with *Decoct. Senn. Gereon. Syr. de Spin. cervin. & Tinct. sacr.* In the interval of the purges, the Dr. gave the patient *Æthiops mineral*, with bitter alterative decoctions, made more carminative with *Rad. Zedoar.*

& *Cas-*

Easter. the patient was relieved for that time; his appetite and complexion mended, but presently he was as bad as ever; then he shewed the Dr. the stones, voided by stool, upon a slight mercurial purge, which he had taken the preceeding *Easter*; upon opening one of them, the Dr. found the patient had swallowed, either some plumb, or apricoc stones, which by their stay in the intestines, were inclosed in the *Feces* as the Dr. supposes, but were dislodged by the purge, and came away; then the Dr. expecting, that if he could remove, by stronger evacuations, any other that might remain, it might tend to his cure, he ordered stronger medicines; however, the Dr. could not bring any more away from the patient, who thereupon left off taking any thing; the Dr. saw him some time after, and found him much in the same condition, tho' somewhat weaker, and more emaciated.

Dr. *Cole* takes these stones to be formed, not of adhering excrements, as Dr. *Holbrooke* seems to suppose, but in the following manner: When the plumb-stones happen to be included in a fit glandulous receptacle, Dr. *Cole* supposes, they may come to be thus coated over by the viscous liquor, secreted from the secretory ducts of those glands, and by long lying there, acquire so large a bulk, by the continual appulse of the same liquor; this receptacle Dr. *Cole* conjectures to be the *Cæcum*, which tho' naturally small, may, as other membranous and glandulous parts, be capable of a considerable distension; so that when by reason of the periſtaltic motion of the intestines above, one of the plumb-stones may by its pointed extremity happen to be intruded, and the whole may by the same repeated tho' slow motion, dilate the cavity in such a manner, that the whole body of the stone may, by the same method, be still farther and farther protruded, till at length it come to the farther extremity, which being shut, must be presumed to detain it there, since it is hard to conceive, how it can quickly get out again, the periſtaltic motion being always forwards; one of these stones being thus entered, it is easy to conceive how more may be admitted, since the first must dilate the passage for another to follow, and so on, till the cavity be full; whilst these stones lie there, they must offend the part, as having distended it, beyond its natural state; so that the secretory ducts of the gland, of which the inner coat of that, as well as the rest of the intestines, is constituted, must be proportionably dilated, whereby an easier way is made for the liquor, they separate to be excreted; this being of a viscid, and concretible nature, must since it cannot get out, be presumed to adhere to the *Subſtratum*, *viz.* the stones, and so by degrees

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degrees incruſtate them; which cruſt, by long confinement, muſt grow ſo much the thicker, the ducts being kept conſtantly open, and the cavity is more and more dilated, the greater the incruſtation is; ſo that the ſymptoms of this patient are eaſily accountable for, from the offence given the part, which is ſenſible, as all membranous, and fibrous parts are, and the pain muſt grow greater, the greater the diſtenſion is; and the change of the poſition of the tumour may very well be conceived to proceed from the different poſitions of the inteſtines, by the chyle, or *Feces* paſſing along them, and ſometimes filling one part, ſometimes another, as they are protruded further and further, their lubricity, length, and confinement, obviouſly favouring that phænomenon: Dr. *Cole* is of opinion, that the true *Benoar* ſtones, are formed in the animals that yield them, in the ſame manner; but whether their ſtomachs, or inteſtines have other cavities, capable of receiving, and retaining them to their full growth, is to be determined by anatomy: This Dr. *Cole* thinks, is certain, that all of them have either a ſtraw, ſtick, or other ſubſtance in the middle of them, different from the exterior matter, and which we call the ſtone, and thence he concludes the manner of their formation to be the ſame: From the continuance of the patient's ſymptoms, Dr. *Cole* was perſuaded, there might be more ſtones remaining behind, and he could not think of any other method, more likely to extrude them, than having the patient's *Abdomen* well anointed, with ſome emollient oils, or liniments, and very well agitated backwards and forwards, as much, and as long, as he could bear, and that both morning and evening; after a little while, when the ſtones by this agitation, may be preſumed to be ſomewhat diſlodged the Dr. ſuppoſes, ſome gentle purgative may be of uſe to be given now, and then to carry them downwards, and to ſollicite it gently with all manner of emollient gliſters, *&c.*

An Ulcer *in the right* Kidney; *by Dr.* James Douglas. Phil. Tranſ. N° 325. p. 52.

IN opening a gentleman, who died in the 45th year of his age, Dr. *Douglas* obſerved when the ſkin, with the other integuments were taken off, that part of the *Omentum* had thruſt itſelf thro' the annular holes of the abdominal muſcles on the left ſide, and there formed an *Epiplocele*, or *Hernia Omentalis*, as large as a walnut; the *Omentum* reached as low down as the *Pubis*, and inſide of the *Ilia*, to which it was tied; and by fibrous connections it adhered to all the *Peritoneum* below the navel; all the fat

fat on the *Omentum*, and guts was firm and hard like tallow; the inteſtines and ſtomach were quite empty, without either wind or *Fæces*; the left kidney was much larger than ordinary, being near eight inches long, and its ſurface was divided into ſeveral diſtinct lobes, as in a *Fœtus*; the right kidney was full of a fœtid purulent matter; all its inner ſubſtance was entirely waſted, and its external or cortical part, was ſtretched ſo very thin, that a gentle touch of the finger could eaſily break thro' it; all the fat, and glands about the right kidney were hard, obſtructed, indurated and big, which very much compreſſed the *Pſoas*, and the *Quadratus lumborum*; the *Ureter* proceeding from this right kidney, was covered with a cruſt, or layer of indurated glands; and beſides its capacity was ſtraitened and contracted in ſeveral places; the cavity of the *Veſica urinaria* was very ſmall, its ſubſtance ſo very thick and hard, that the Dr. could not even with a blow-pipe diſtend it any wider; its inſide ſeemed excoriated, with ſeveral fleſhy caruncles, or red excreſcencies here and there; there was a remarkable corroſion in all the inſide of the *Urethra*; all the upper and convex part of the liver firmly adhered to the *Peritonæum*, that covers the diaphragm, and to the ſame membrane, where it covers part of the *Muſculus abdominis tranſverſalis*; its ſubſtance was ſo very tender, and ſoft, that it ſeemed to be almoſt rotten; the gall-bladder was extremely large and full, the bilious liquor it contained, being of a whitiſh yellow colour; between the *Tunica vaginalis & albuginea* of the left teſticle, there was a large hydatical or watery tumour; and upon the laſt named coat of the ſame teſticle, there were ſeveral chalky concretions, about the bigneſs of a barley-corn each; in the right auricle of the heart there was a large *Polypus*, that filled up its cavity, extending itſelf a great way, into the aſcending and deſcending trunks of the *Vena cava*; all the reſt of the *Viſcera* were in a natural ſtate: The ſymptoms this patient complained of during his illneſs, as the Dr. was informed by thoſe who attended him, were, that about a year and a half before his death, he began to decline in health; his firſt complaints were a heat, ſharpneſs, or pain in making water; a conſtant deſire to make urine, tho' in great miſery after; when his water ſtood awhile, there appeared a greaſy ſubſtance on its ſurface, not unlike the cream or ice, that is found on the the top of *Aqua calcis vivæ*; ſometime after it depoſited a purulent matter, in a great quantity, but without any offenſive ſmell; the water when made was thick, and whitiſh, but when the *Pus* ſettled to the bottom of the pot, it became clear; he ſeldom complained of any great pain in his

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back, or loins, whence they concluded, the ulcer was in the neck of the bladder, tho' the vaſt diſcharge of matter was an argument to the contrary; but he was always on the rack, when he roſe up after ſitting, and it was a great difficulty to him to get up, which perhaps, was occaſioned by the weight and preſſure of the kidney, and adjacent indurated glands, lying on the head of the *Pſoas* muſcle, and *Quadratus lumborum*; he had often a total ſuppreſſion of urine; but was much relieved by *Sal Succini* and *Cornu Cervi:* He took ſeveral doſes of *Cantharides*, with camphire, without any bad effects from the fly, but with little relief to his diſtemper; for three weeks before his death he was ſeized with a violent looſeneſs, which at laſt, in ſpite of all means, carried him off.

The Oſteology *of an* Elephant, *with a brief Account of its* Parts; *by Mr.* Blair. Phil. Tranſ. N° 326. p. 53.

THAT the *Behemoth* mentioned *Job.* lx. v. 15. *&c.* is not the elephant, but rather the hippopotamos, *Bochart* proves by the following arguments. 1. As land animals, ſuch as quadrupeds and fowls are ſpoken of in *Job.* chap. xxix. ſo *Behemoth* and *Leviathan*, as belonging more properly to the waters, are treated of in chap. lx and lxi. 2. The force of the *Behemoth* is ſaid to be in the navel of his belly, whereas it is the ſofteſt part of the elephant; but in the hippopotamos it is ſo thick and impenetrable, that it reſiſts both ſpear and dart, which he abundantly proves from authors. 3. The *Behemoth* is ſaid to move his tail like a cedar; now the tail of an elephant is long like that of an ox, and but ſmall in proportion to the body; and to move like a cedar, would import ſome ſtrong round ſubſtance, and rather ſeems to agree with what *Bellonius* affirms of the hippopotamos, viz. *Caudam habet brevem, craſſam & rotundam*; tho' *Bochart* renders it, *Retorquet, & non arrigit caudam*, as *Junius* has it. 4. *Bochart* ſays, that the word in the original will not imply *Nervis teſtium ipſius*, as *Junius* has it, but *Nervis femorum*, &c. Not the ſinews of his *Teſtes*, but thoſe of his thighs are intricate. 5. The elephant ſeldom lies down, and never in the covert of reeds and fens; for tho' it love water very well, yet it would be very noxious to ſuch an unweildy animal to lie down among ſuch moiſture, as reeds uſually grow in, or the being among the willows of the brook would import. 6. At the taking of an elephant, they never pretend to enſnare it by the *Proboſcis*, it being more likely for the hippopotamos to paſs thro' ſnares; the uſual way of catching this latter being with nets made

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made of iron, which they make on purpose at *Damascus*, as *Albertus* and *Vincentius* affirm; and when taken, it is no ways manageable, but they are obliged to kill it with iron mallets, because of the thickness of its skin, whereas the elephant is a very docile animal. 7. Tho' the bones of the elephant be proportionably large enough, yet they are far from being so strong, as to make a parallel between them and brass or iron, for they are more porous than those of most quadrupeds; and tho' their tusks and teeth may be said to exceed all other bones in solidity and whiteness, yet the teeth of the hippopotamos, do even exceed them; for the ivory of an elephant after some time becomes yellow, whereas the teeth of an hippopotamos, when applied to any use, continue always of a pure white colour.

The elephant is said to live to a great age, some asserting they live to 120 years, others to 200; some to 300; and there are some who affirm, that they live to be 500 years old, and that they are very strong and robust at 200 years: *Tentzelius* tells us, that when a certain *German*, who had been in the *Indies*, saw the bones he treats of, concluded from certain marks the *Indians* have, that that elephant could not have been under 200 years of age: M. *Tavernier* in his *Travels in India*, p. 96. says, he could never learn exactly, how long the elephant lived, but that their keepers told him, they knew such an elephant to have been in their great grand-father, grand-father, and father's custody, which he modestly computes not to have been under 120 or 130 years; and it is memorable what *Juba* king of *Lybia* told, as related by *Philostratus*; viz. that the knights of *Lybia* at a certain time fought upon elephants, some of which had a tower engraven on their teeth; and when they were separated by the night, such as had the tower were beat, and fled to mount *Atlas*, and that *Juba* 400 years after, took one of them, which had this mark engraven as lively, as if it had been newly done: Howevever, they seem generally, to live to a great age; for the keeper told Mr. *Blair*, that this elephant was 26 or 28 years old, tho' she seemed to have been young; for the *Epiphyses* were as easily separated from the bones by boiling, as those of an human subject at the age of 10 or 12; and yet it is an animal subject to several distempers, so that tho' they may live to some of the above-mentioned ages, yet generally they die before they come to such a length.

It is an animal of considerable bulk; but whether ever so large as to contain 32 strong men on its back, as is related *Maccab.* chap. vi. v. 37. besides the *Indian* that governed it, is much to be

doubted; and it is more probable, that this is an error in the impreſſion, as is well enough obſerved by *Grentemeſnil*; who inſtead of Ἄνδρες δυναμεως δυο ἢ τριακοντα οἱ πολεμιστες ἐν αὐτοῖς, *Viri fortes duo & triginta pugnantes in iis*, thinks it ſhould be rather Ἄνδρες δυναμεως δυο ἢ τρεις ἀκοντιοις πολεμιστες ἐπ' αὐτοῖς, *Viri fortes duo aut tres pugnantes ſuper ipſos jaculis*. *Bochart. de Animal. S. S. Script.* c. 27. col. 269. It is true *Philoſtratus*, lib. 2. cap. 1. ſpeaks of 10 or 15 *Indians* fighting with darts in caſtles on the backs of elephants; and *Paulus Vineta*, lib. 3. cap. 41. ſays, that in the *Ginger Iſlands* they have wooden caſtles on elephants backs, which can contain 15 or 20 men; but the learned *Bochart* very pleaſantly ſays, of theſe authors, that *de magnis majora loquuntur*, becauſe this is a large animal, they ſpeak at random of it; Mr. *Blair* rather believes, what *Heliodorus*, lib. 9. ſays, that the towers on the elephants backs could contain ſix fighting men, who from each ſide threw darts, the hinder part remaining naked; or what *Cadamuſtus* relates, c. 62. that they put towers upon their backs, which can hold three or four fighting men; and *Ælianus* affirms, that they carry three warriors fighting from either ſide, and a fourth that governs them; which three laſt accounts ſeem very well to quadrate with the uſual height aſcribed to them, about which ſome authors talking more largely, tell us of 18 or 16 foot high; but the moſt received account is, that they are from 8 to 13 foot high.

As to their manner of procreation, all do agree that it is an animal of extraordinary modeſty, and therefore never copulates in view of any one; as to the poſture, ſome, as Dr. *Moulins* from an obſervation he made of the ſituation and ſtructure of the *Penis*, aſſert that it is retrocoient and retromingent: Others obſerving the diſtance between the *Anus* and *Vagina*, and that the dugs are ſituated between the fore-limbs, are of opinion that the female is in a ſupine, and the male in a prone poſture; and M. *Tavernier* is of this opinion, who tells us, that 'the female gathers a great deal 'of herbs and weeds, and makes a bed four or five foot high from 'the ground, on which ſhe throws herſelf, and lies on her back 'in expectation of the male, whom ſhe invites by a peculiar 'cry;' and that may be the reaſon why the dugs are placed ſo forwards, to avoid the preſſure: A third opinion is, that the female deſcends into a ditch, and that the *Coitus* is not different from that of other animals. As to the firſt Mr. *Blair* ſcarce thinks it probable, becauſe there can be no ſuch thing as a retrocoient animal; for that would quite invert the order of nature, and

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and give a far different motion to the muſcles of the thighs, than they can be ſuppoſed to have from their ſituation; and hares, cats, rabbits, &c. that are ſaid to be retrocoient, copulate no other way, than dogs and other quadrupeds; and that retrograde poſture, wherein dogs are ſometimes obſerved, is nothing but an endeavour to get rid, when by the ſwelling of the glans, the male and female are too cloſe together, and far from a deſign of penetrating farther into the *Vagina*: As to the ſecond opinion, were it not for M. *Tavernier*'s aſſertion, it ſhould ſeem too unweildy an animal, and little inclinable to lie down, to acquire ſuch a poſture: As to the third opinion, the natural ſagacity of the female diſpoſes her to go into the ditch; and both fore and hinder legs ſeem to be ſo articulated as to favour this; for when the female would lower her body, no more is requiſite than to ſtretch forwards her fore-feet, and then the articulation of the *Humerus* with the *Cubitus* will bend backwards, and after that to bring back her hind-feet in ſuch a manner as to bend her knees forwards; by which ſhe can bring the fore-part of her body ſo low, as to make the *Nates* protuberant, and bend the hind-legs, thereby to put the *Vagina* in a convenient poſition for the reception of the *Penis*; according to that of *Ariſtotle*, *Subſiſtit femina, clunibuſque ſubmiſſis, inſiſtit pedibus ac innitur*; and elſewhere, *flectit certè ſuos poſteriores poplites modo hominis*.

What time they begin to copulate is uncertain, tho' from their uſual term of life, authors ſeem probably to conjecture, that ſome begin at five years, others much later, and not till the 20th: The time of their going with young is alſo diſputed; for their innate modeſty prevents ſuch, as would obſerve them, from determining any thing with certainty; the only way to know, is, to obſerve their ſeparating themſelves from the herd; for it is a gregarious animal; and it is the male and female go apart (and if any obſerve them at that time, the male runs upon them with fury and madneſs) and do not return till the female be impregnated: Some fondly imagine, from their extraordinary bulk, that they go with young nine years, others ſix, and others two; but it ſeems moſt probable, that they go with young 15 or 16 months; and if we obſerve the ordinary courſe of geſtation in other viviparous animals, it is according to their bulk and term of life, that the female uſually goes with young; thus bitches and cats go but nine weeks, while mares and cows go nine months; ſo that *cæteris paribus*, this our animal may be ſuppoſed to go 15 or 16 months; and Mr. *Knox*, in his account of the iſland of *Ceylan*, tells us, that they do not go with young above

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above a year; ſome ſay, they bring forth every third year, and others never but once in their lives, *Act. Lipſ. Suppl. Par.* 1. p. 39; the firſt opinion may be probable, but the ſecond is ſcarcely to be credited; for it would be ſtill more wonderful, and next to an impoſſibility to ſee ſuch numbers of elephants in armies and countries, as we read of: M. *Tavernier* tells us, that he has been informed, that the *Great Mogul* keeps 3 or 4000 elephants; but that the chief maſter aſſured him, he had not above 500 ſaid to be of his houſe, and deſigned for carrying women, tents, *&c.* and about 80 or 90 for war; which is a great number of tamed ones; and thence we may ſuppoſe, that there muſt be a far greater number of wild ones in his dominions, beſides what are in the kingdom of *Pegu* (where as *Schotto* relates from *Garzias ab Orta*, *Mirab. Animal. terreſt. Lib.* 8. at one hunting there were 4000 taken at once) *Siam*, *Cochin*, and *Boutan* near *Great Tartary*, beſides thoſe of the iſland of *Sumatra* and *Ceylan:* It is ſaid that the male never copulates with the female, after once ſhe is impregnated; and ſome would perſuade us, that every male keeps to his own female; it is alſo ſaid to be a very temperate animal, and ſeldom in luſt: *Tavernier* tells us, that the male never meddles with the female, when once he is taken, but is ſometimes ſeiſed with a luſtful rage, whereof he gives a memorable inſtance p. 95. whether this rage proceed from luſt, or whether it be a kind of madneſs, which Mr. *Knox* in the above-cited place tell us, they are ſeiſed with at certain ſeaſons, and which is known by the efflux of a liquor from their jaws like oil, and which afterwards goes off of its own accord, Mr. *Blair* will not determine, but it is probably the latter; the ſaid Mr. *Knox* adds, that the female elephants ſuckle indifferently the young ones of others, as well as their own: It is reported of them, that they only bring forth one at a time; and that it is about the bigneſs of a hog, or as ſome ſay of a large calf, which ſeems to agree with *Tavernier*'s account; who tells us, that when the merchants bring the elephants to ſell, the children uſually leap upon their backs, which could not well be, were they higher; they are ſaid to ſuck for ſix years, or according to ſome eight years; tho' Mr. *Blair* rather inclines to the opinion of thoſe, who tells us, they quit their dam at ſix months, if it be true, that when they are brought forth, they both ſee and walk; for if ſo, they may as ſoon be capable of purchaſing their food, as colts and calves.

The natural food of the elephant is graſs, and when that is wanting, they dig up roots with their tuſks; this perhaps may be

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be one of the reaſons, why the *Behemoth* is taken for the elephant, becauſe it is ſaid *to eat hay like an ox*; but that as *Bochart* tells us, is likewiſe common to the *Hippopotamos*; they are ſaid greatly to delight in cucumbers and melons, and to have a particular inſtinct in avoiding whatever herbs may be noxious to them; it is alſo obſervable, they avoid coming near any graſs that has been trodden on by men, for fear of ſnares; when they are tamed they eat hay, oats, barley, or ſuch other food, as oxen or horſes do; they drink a large quantity of water, which they ſuck up by the trunk, and when that is full, they empty it into the mouth, they naturally affect muddy water rather than clear; when tame, they drink clear water readily enough, when they are to go to battle, they give them ſpirituous liquors, ſuch as wine, *&c.* in order to make them drunk and furious; as appears from the hiſtory in the third book of *Maccab. Chap.* vi. They have a very acute ſenſe of ſmelling, whereby they readily find out their food.

Pliny ſays, that the elephant is, *Animal maximum, proximumque humanis ſenſibus*; as appears in the care of their young, for they rather chuſe to loſe their own lives, than that they ſhould loſe theirs; they always go in herds, and the largeſt go foremoſt; and when they are to paſs a river, they lift the young ones acroſs on their two tuſks, and twiſt the *Proboſcis* round about their middle, and make ſuch as are bigger go before them, the largeſt coming laſt; for did the largeſt paſs firſt, the river might chance to be ſo deep, that neither the leſſer ones could paſs, nor the larger ones ſo readily aſſiſt them; when they paſs by any of their dead, they cover the carcaſe with branches of trees, graſs, or what elſe they can get; when any is wounded, the reſt of the elephants take care of him, bring him food, relieve him from danger, and run together to ſave him from the hunter; when a ſnare is laid for them they ſoon perceive it; if it be a ditch, he that is neareſt halts (by an inſtinct, as it were) which when the reſt perceive, they immediately return with fury upon the hunter; *Tavernier loc. citat.* tells us, that being once deceiv'd, and having eſcap'd the ſnare, they ever after are very diſtruſtful; and when they get to the woods again, they break off a large bough from one of the trees with their trunk, with which they examine every ſtep they take, before they ſet down their feet, to try if there be any hole in their way; when they travel in troops, if any one of them perceives an herb, whereon any man has trodden, he pulls it up, and delivers it to the next, who ſmells it, and gives it to a third, and ſo on till it come to the laſt, who makes

makes a great noiſe; upon which all betake themſelves to flight, and retire to hills and mountains, and to ſhady and other leſs frequented places, where when graſs fails, ſome dig up roots, others go and pull tender buds, herbs and leaves of trees; and the firſt that finds any thing, returns and aſſembles the reſt of the herd, that he may communicate to them what he has purchaſed; when they are in battle, ſuch as are wearied or wounded, return to the multitude, and ſuch as have been leſs expoſed, advance of their own accord; when they are to paſs over a ditch, one or more go down (according to its breadth) and ſtand a-croſs it, where making a bridge as it were, all the reſt ſtepping on their backs, paſs over; when all have paſt, thoſe in the ditch are brought out in the following manner; one ſtands at the ſide of the ditch, and ſtretches out his foot, which he that is in the ditch takes hold of, by twiſting his *Proboſcis* round it; then the reſt make haſte, and provide branches of trees, which they throw in, that he may the more eaſily ſtep up upon them.

Their love, fidelity and gratitude is ſurpriſing; *Ælianus* tells us, that when *Porus* king of *India* was ſubdued by *Alexander the Great*, he was wounded with ſeveral darts, which the elephant he rode upon pulled out of his body with his *Proboſcis*, and when he perceived his maſter faintiſh by the loſs of blood, gradually leaned himſelf down, till he fell flat upon the ground, that his maſter might receive no hurt by alighting off; there is alſo a ſtory related by *Athenæus lib.* 13. of the gratitude of an elephant to a woman, who had done him ſome piece of ſervice; ſhe laid her child by him, when it was only 30 days old, but afterwards the woman dying, he loved the child in ſuch a manner, that he could not endure it from him; therefore, whenever the nurſe ſuckled the child, ſhe laid it in a cradle between his feet, which if ſhe had not done, he would forbear to eat, but if ſhe did, he would eat cheerfully by the child the whole day; when the child ſlept he chaſed away the flies with his *Proboſcis*, and when it cried, he would toſs or rock the cradle, and thereby ſet the child aſleep again: But as their love and gratitude is great, ſo likewiſe are they ſubject to wrath and revenge; *Michael Glycas Annal. Par.* 1. tells us, that when an elephant was brought into a theatre, he ſaw as he came along a keeper of wild beaſts, ſitting in the market place, whom in a paſſion, he ſuddenly killed, and that the occaſion of this revenge was, becauſe the ſaid keeper about 10 years before had ſtruck him with a ſword in that ſame place; and *Acoſta* writes, that a ſoldier in the town of *Cochine* had thrown the kernel of a nut at an elephant, which

which the elephant took up and carefully hid; ſome days after, the elephant ſeeing the ſoldier paſs by, threw it into his face, and made a great noiſe, and went away leaping and dancing; in that ſame town another ſoldier, meeting an elephant with his keeper, would not give way to them, whereupon the keeper complained to the elephant of the affront, who ſome days after ſtanding on the river *Mangata*, which runs thro' the town, and ſeeing the ſoldier ſtand idle, ran haſtily towards him, lifted him up on his *Proboſcis*, and plunged him ſeveral times in the river, after which he drew him out, and left him where he found him.

The manner of taking elephants is as follows. 1. They dig deep ditches, and cover them with branches of trees, &c. which tho' the elephants may ſometimes perceive, as has been ſaid, yet they are frequently enſnared therein; when any fall in, the reſt are ready to throw in branches of trees, and ſuch other materials as they can get, to ſee if by any means they can rid their companion: Another method uſed by the king of *Pegu* is, he builds priſons for them of wooden pillars, at ſuch a diſtance from each other, as to ſuffer a man to paſs, but not an elephant; then he cauſes to be let looſe into the woods ſome tame females, whoſe *Pudenda* are anointed with a certain oil, for enticing the male; and taking care that they do not copulate, they drive all together towards the priſon, whence they convey the females into ſtables, which can contain no more than one at a time, and the males, hot in purſuit, are caught among the pillars, and ſome by-ſtanders immediately lay pales of wood a-croſs to hinder their return; when the elephants perceive the cheat, they fall into a rage and fury, and groan, even to the ſhedding of tears, and run up and down, till they are all in a ſweat; when the hunters deſign to put them into ſtables, they let them ſee the females again, whom they lead foremoſt, and the males follow them to the intended place, which is ſo little, that it admits no more than one at a time; then they remove the female, and tie the male by the neck to a ſtall, till tired out both by hunger and grief, they become more tame, which is uſually after eight days faſting, and then the keeper teaches and manages them as he pleaſes: A third method uſed by the ſaid king in taking them is this, he employs a vaſt number of men to ſurround the whole foreſt, where the elephants haunt, and incloſing them within narrow bounds, he picks and chuſes ſuch as he has a mind to, and lets the reſt go: What *Edward Lopez* relates is very remarkable, that when a young elephant was caught in one of theſe ſnares, the old one ran with violence, to get it out, of which being diſ-

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appointed, ſhe threw in earth, trees and ſtones in ſuch quantity, that they filled the ditch, and rather choſe to deſtroy it, than let it fall into the hands of the enemy: But if what authors have told us of their manner of taming be true, it is a ſurpriſing proof of their natural ſagacity; after they are taken, they hedge each of them in with large rafters, till they be incloſed in ſuch narrow bounds, that they can ſcarce have room to ſtand; then they tie their feet and tuſks together in ſuch a manner, that they cannot ſtir; their keepers mount them, girt about with two ropes, and ſtriking with their heels and clubs, threaten to beat them, and to ſtarve them till they die: but if they will be quiet and peaceable, they promiſe to be kind to them, anoint them with oil, and give them meat and drink in abundance; then they take one of theſe wild ones, and place him between two tame ones, and ſo confine him on both ſides, till he is ſufficiently tame: *Tavernier* tells us, that he once ſaw two wild elephants, each of which had a tame one placed on each ſide; round about the wild elephants ſtood ſix men, each with a half pike in his hand, and a lighted torch faſtened at the end of the pike, and talking to the elephants, gave them food, which was a ſmall bottle of hay, ſome pieces of brown ſugar, and rice boiled in water, with ſome few corns of pepper; if the wild elephants refuſed to do as they were bidden, the men made ſigns to the tame elephants to beat them, which they did, banging the refractory one with their trunks on the head and fore-head, and if he offered to make any reſiſtance, the others thwart him on the other ſide, ſo that the poor beaſt was conſtrained to learn obedience; it is ſaid, that theſe methods ſoon take with the younger ſort, but for the old ones they put them into large houſes, and treat them very harſhly, by wounding them with darts, and ſtarving them till they be half dead, and then by gentle methods, and fair promiſes they tame them; *Ælianus* ſays, when all other methods prove ineffectual with an old one, they have a certain kind of muſical inſtrument, whereon they play their own natural tune, to which they become ſo attentive, that they are ſoon taken with the ſweetneſs of the melody, and laying aſide their wildneſs, begin to look to the meat that is offered them; and tho' they ſhould take off their fetters, they forget their former rudeneſs, and fall to their food with greedineſs and appetite: That it is a very docile animal all agree, and authors tell ſurpriſing ſtories of them; ſuch as their dancing to a pipe, and keeping time, leaping, ſkipping, gathering and ſtrewing flowers, exerciſing fuzee and pike, like a ſoldier, and playing a great many odd tricks in theatre,

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theaters, and even writing, and understanding human speech: When it is sorrowful, it hangs the *Proboscis* down to the ground, and by the same *Proboscis* it discovers its joy; it is an animal very vain-glorious and proud, when finely dressed and richly adorned.

The elephant that is the subject of this dissection was a female, and died in 1706 near *Dundee* in *Scotland*: Mr. *Blair* agrees with *Frantzius*, that an elephant is *Animal vastissimum*; but he can hardly grant, that it is deformed, since those due proportions, laid down by the author of nature are as well observed in this, as in any other animal; for nothing can be deformed, but what swerves from a general rule; it has a large short head; short neck; long nose, or *Proboscis*, hanging almost down to the ground; a back somewhat protuberant; a short and round body; a long tail; four large round legs, like so many columns, supporting such a vast weight; and short feet, those before being broader and rounder, and those behind longer and narrower, each shod with four hoofs; a little narrow mouth, with two long tusks, proceeding from the upper jaw, one on each side of the *Proboscis*; four strong grinders in each jaw; small yet piercing eyes, and large flat ears.

Plate VI. Fig. 20. represents the stuffed skin of the elephant; at the fore-leg she was eight foot and a half high A A; and nine foot at the hinder-leg B B; in length 10 foot C C; and the tail four foot three inches long C D; round the belly 14 foot E E; from the top of the head to the extremity of the *Proboscis* eight foot F F; whereof the *Proboscis* made four foot and a half F G; from the forehead even with the eye, to the lower jaw, measuring backwards 27 inches H H; from the top of the head to the lower jaw, measuring downwards four foot and a half F I; the ear was almost square in this subject, and small in respect of those in other animals; whether this difference might not be owing to the sex, Mr. *Blair* could not determine; it was 19 inches long K K; and 17 inches broad L L; the eye U was not so small as Dr. *Moulins* would have it, who says, they were no bigger in the subject he treats of, than those of a sheep; whereas in this subject they were bigger than those of an ox; the distance between them measured a-cross, was 26 inches; between the *Anus* and *Vagina* there were two foot and a half; between the dugs one foot; the fore-foot, measuring round the extremities of the four hoofs, was three foot 10 inches and a half N N, whereof the external hoof, running obliquely forwards, was five inches; the second on the outside, square before, was five inches, and six

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inches in breadth, *i. e.* up towards the skin; as was the third likewise square before, and 4 inches and $\frac{1}{2}$ *b*; the internal hoof was more pointed, than the external, and of the same length; the hinder-part of the foot was covered with a tough thick skin; the diameter of the fore-foot, from the right to the left, was 14 inches and $\frac{1}{2}$, and from the fore to the hinder-part 16 inches and $\frac{1}{2}$; the circumference of the fore-leg at the upper joint, was four foot three inches, as O O; at the articulation of the *Carpus*, two foot six inches and $\frac{1}{2}$, as P P; the circumference of the hinder foot round the hoof, was three foot four inches Q Q; its diameter from the hinder to the fore-part, 16 inches and $\frac{1}{2}$, and from the right to the left 12 inches; the breadth of the outer hoof was four inches and $\frac{1}{2}$, as *b*; the fore-hoof being semicircular, was three inches and $\frac{1}{2}$, as *a*; the third and fourth hoof were four inches each; both the inner and outer hoof go obliquely forwards; the circumference of the hinder leg, was two foot two inches, as R R: Dr. *Moulins* has at large, and very judiciously described the *Cuticula* and *Cutis*; he found the *Cuticula* covered all over with an odd sort of scab, in several places resembling warts deeply jagged, and the carnous fibres of the muscles of beef, when much boiled and cut transversly, but of a dirty tawny colour; these scabs, if they may be so called, do both slit and look like short pieces of whale-bone; they adhered so firmly to the *Cuticula*, that they could not be separated therefrom, nor could the parts of which they consisted (tho' much divided) be separated from each other, without tearing the *Cuticula*, which yet was very tough and thick; the length of these scabs in some places exceeded $\frac{1}{3}$ or $\frac{1}{4}$ of an inch, but in other places, not a tenth or twelfth; the cause of which difference the Dr. takes to be owing to the elephants wearing off some parts, by rubbing or lying, whilst others were slightly or not at all worn: The scabs in this subject were not so long; for as the deepest Mr. *Blair* could find on the *Cuticula*, were not above a third of an inch, so others did not exceed a sixteenth of an inch: Dr. *Moulins* says, that he could find but very few hairs appearing above this scab, but several below, and in a level therewith; the elephant's inclination to itch, and rub himself against whatever came in his way, kept those hairs that were even with the outside of the scabs, from appearing of any considerable length, and the hardness of the scab did very much contribute to their wearing above, as well as to their preservation below: In this subject the hairs were every where pretty long, some two and others three inches, and some again in the places most exposed to rubbing, as the Dr. observes, but an inch, or half an inch, tho' indeed not so numerous as

Mr. *Blair*

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Mr. *Blair* found them, and there are paſſages for them thro' the *Cuticula*; Mr. *Blair* does not know what the Dr. means, when he diſtinguiſhes between thoſe found in the *Cutis*, and thoſe in the *Cuticula*, ſince he was convinced, that all ariſe from the *Cutis*, and penetrate the *Cuticula*; they are indeed black, and ſeveral of them ſtiffer and thicker, than the briſtles in a hog.

Some take the *Cuticula* to be no other than a certain cruſt, formed of ſeveral mucilaginous particles, covering the *Cutis*, &c. in the *Uterus*, which after the *Fœtus* is come to maturity, are condenſed and formed into a ſkin, ſuch as we obſerve mucilages and poultices have, when after boiling they are expoſed to the air; others ſuppoſe that the *Cuticula*, as well as *Cutis*, conſiſts of a *Congeries* of membranous fibres, intermixed with a great many capillaries, and endued with pores for perſpiration; and ſome anatomiſts aſſert, that they have injected theſe cutaneous veſſels in the *Cuticula* of a *Fœtus*, as well as in the *Cutis*; tho' when the animal is more adult, theſe capillaries eſcape not only the view of the naked, but even armed eye; that this has been the ſtructure of the *Cuticula* in this animal, is moſt plain and obvious; for, tho' Mr. *Blair* could not determine its thickneſs, as Dr. *Moulins* might have done in a recent ſubject; yet now it was dry, it ſeemed to be of the thickneſs, or rather thicker than common vellum, with its inner ſurface excavated or pitted, in the manner of a thimble, or honey-comb; amongſt the interſtices of theſe excavations, the ramifications, and divarications of the blood-veſſels were obvious; at every two lines, or ſixth of an inch diſtance, for the moſt part might be obſerved protuberances, conſiſting of five, ſix, or ſeven columns, joining and forming a pyramid, or cone, in whoſe vertex is the pore or *Ductus*, mentioned by Dr. *Moulins*, thro' which the hairs paſs; and they are no other than the interſtices of the *Favi*, or depreſſions ariſing in the *Cuticula* and impacted in the *Cutis*, for the better reception of the hair; and it is probable, that all the hairs are covered over with thin membranes, as Dr. *Moulins* obſerves, from the extremity of their roots to the *Cuticula*; becauſe upon pulling out ſeveral of them, Mr. *Blair* obſerved them included within their proper *Involucra*, and he doubts not but all the reſt were ſo too, beſides the common *Involucrum*, which is contiguous to, and continuous with the *Cuticula*; the hairs are looſer, and the pores more patent and obvious in the *Cuticula* when dried, than he ſuppoſes they were when recent; but whether theſe pores were likewiſe deſigned for perſpiration, or only to contain and convey the hairs planted in the *Cutis*, through the *Cuticula*, Mr. *Blair* could not determine:

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To the outside of the *Cuticula* adhered the ſcabs, which Mr. *Blair* takes to be a ſupervenient diſtemper, incident to this animal, when out of its native climate, and occaſioned by the conſtriction of the pores by cold, rather than any ways natural thereto; and with this the accounts of all authors agree, who tell us, that there are two kinds of elephants, the one of a darker colour, and the other duſkiſh and fad; both having their ſkins of a very ſmooth and poliſhed ſurface; wherefore the keepers of this elephant, called it the white elephant, in oppoſition to the black ones; but after they are affected with the ſcab, this diſtinction of colours is not obſerved. Authors tell us, that the firſt thing they do, when they begin to tame them, is to anoint them with oil, whereby they keep their ſkin ſmooth, ſoft and flexible, and relax their pores in ſuch a manner, that whatever groſs particles may fly off from their blood, whoſe conſtitution is perhaps worſe, by the alteration of diet, and the hardſhips they undergo at taming, may not ſtick to the ſkin, but be freely evaporated; and Mr. *Blair* was credibly informed, by ſuch as lived long in the *Indies*, that they take as much care to keep the ſkins of the elephants ſmooth and clear, as we do our fine horſes; theſe ſcabs ſeem to Mr. *Blair* to ariſe from the groſſneſs and viſcidity of the blood, whoſe particles, becauſe the pores are obſtructed by a cold too exceſſive for their bodies, do not ſo eaſily fly off; but after they have paſſed the *Cuticula*, go no farther than its ſurface, and becauſe of the viſcidity of their texture, cleave to each other, and are accumulated in ſuch a manner, as to appear like a ſcab, which by the evaporation of the more humid particles, harden by degrees, and by the heat of the ſun are cracked, rent and divided; That the coldneſs of the weather will occaſion groſs and viſcous blood; no one that is acquainted with the diſtempers in theſe northern countries, will readily deny, nor that moſt of theſe diſtempers proceed, from obſtructions of the capillaries and pores; and that this may be the cauſe of *theſe* ſcabs, appears from the following particular, *viz.* whatever pieces of the *Cuticula*, Mr. *Blair* obſerved where the ſcales were thin, there the *Favi*, or depreſſions were large, and conſpicuous; but where they were thick, there the *Favi* were very ſmall, and almoſt imperceptible, which plainly implies, that wherever theſe particles perſpire freely, few adhere to the ſurface of the ſkin; but when their force is checked by the ſtraitneſs of the pores, they cannot remove any farther, but adhere to, and augment the bulk of the ſcab; theſe ſcabs are divided from each other; by ſeveral *Rimæ*, or rents, which may be occaſioned, either by the heat of the ſun, or by the different poſition the

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skin is put into, by the several motions of the body; hence it is, that where the skin is most wrinkled, these *Rimæ* are most frequent: It may be said, that this reasoning seems to contradict what Dr. *Moulins* has asserted, *viz.* that this animal has a very subtile blood, copiously repleniſhed with a penetrating, urinous salt; which he proves from the vivacity of the species, from the urinous effluvia that affect the noſtrils, and from the smarting of the finger by the blood, after being cut; as to the first, that it is a very vivacious and spirituous animal, appears both from the foregoing relation, and the account of authors; but that does not hinder, but its blood might be incraſſated by cold, and bad diet, and these scabs proceed from this groſs blood; as to the second, Dr. *Moulins* might have been sensible of a plentiful urinous salt in his subject, yet it does not follow that it should be so in all, and Mr. *Blair* was apt to believe this was an extraordinary case; for as that poor animal was burnt alive, so it muſt have had the constitution of the blood altered, and made quite different from what it was; and it is probable, that it was in such places, as were moſt affected with the burning, that the Dr. felt this urinous smell, and the smarting of his finger; whereas Mr. *Blair* obſerv'd, that the blood of this subject was styptic and astringent; so that when his hands were imbrued therein, he could scarcely bend a finger, and the same effect he also perceived at the diſſecting of fiſhes, whoſe blood all acknowledge to be viſcous: But it may be objected, that this subject dying morbid, and of a languiſhing diſtemper, the blood of the one might be groſs and viſcous, and yet that of the other spirituous, and subtile: Mr. *Blair* owns he would be ready to acknowledge the validity of the objection, if he did not underſtand, that both were affected with the same scab, and the other more so than this.

Dr. *Moulins* obſerved, that the inner surface of the *Cutis* was furniſhed with a great many glands; when cut through, at leaſt, as far as the roots of the hair went, it was like the horny or callous part of brawn, and its external surface had a great many *Papillæ*: Mr. *Blair* had no opportunity to obſerve any of these; but he was apt to think it was so; and first, as to the *Papillæ*, it was said above, that the *Cuticula* was endued with a vaſt many *Pori*, or depreſſions, wherein he doubts not, but these *Papillæ* were received, tho' the surface of the *Cutis*, when dried, was smooth, and where the *Papillæ* seemed formerly to have been, there were rather depreſſions than protuberances; which shews, that there was some kind of liquor contained in these *Papillæ*, or veſſels, which on the drying of the skin, evaporated; and there-

therefore he ſuppoſes, this brawny part of the *cutis* to be a congeries of excretory ducts running in a parallel line from theſe glands to the veſſels, and conveying the liquor to be contained therein, till it be evaporated by perſpiration; and theſe veſſels ſeem to have been both ſo large and numerous in this animal, as to make up at leaſt two parts of the inner ſurface of the *cuticula*, the blood-veſſels, and depreſſions together, ſcarcely making up a third part; they alſo ſeem to be half lodged in the *cutis*, and half in the *cuticula*; for in ſome places of the *cutis*, he obſerved the depreſſions as numerous, and ſeemingly parallel to thoſe in the *cuticula*; and that notwithſtanding the *membranulæ*, wherein the humour was included, being dried and collapſed, might take up ſome ſpace in the depreſſion of the *cutis*: By this account both of the *cuticula* and *cutis*; Mr. *Blair* queries 1. How the one ſhould ſo firmly adhere to the other, when there ſeems to be no communication between them by fibres? As appears by their eaſy ſeparation, both by fire and water. 2. How conſiderable the perſpiration may be? As to the firſt, ſince the *cutis* and *cuticula* are two diſtinct membranes, their cohefion ſeems to be mutual; firſt theſe pyramids, which receive the hairs, are impacted into the *cutis*, and cloſely ſurround their roots; and then theſe *Papillæ* are impacted into the *cuticula*, which as long as they are diſtended with the humour fit for perſpiration, will not readily quit the depreſſions in the *cuticula*, unleſs the humour be ſuddenly evaporated by fire, or the ſides of theſe depreſſions, or *cellulæ* be relaxed by water; and there may be a certain viſcoſity, which covers the ſurface of both, like ſo much glue, which either the fire may dry up too much, or the water dilate; ſo that the one may be ſoon ſeparated from the other, and the hairs be either pulled from their places, or quit their common *Involucrum*: As to the ſecond query, *viz.* the perſpiration; Dr. *Moulins* ſays, that the pores muſt be both numerous, and large for perſpiration; eſpecially if we conſider *Sanctorius*'s ſtatical obſervations of a man's inſenſibly perſpiring in a winter's day 50 ounces and upwards, which is ſomething more than $\frac{1}{34}$ of an ordinary man's weight, ſuppoſing him to be 170*l.* and at this rate, we muſt ſuppoſe, the perſpiration of an elephant to be vaſtly greater; but as he ſays, it is probable, the ſcabs might hinder it from bearing proportion to that of a man: So that whatever the elephant might have perſpired in a healthy ſtate, we may reaſonably ſuppoſe it to be much leſs, when affected with this diſeaſe, which may be another argument for the groſſneſs, and

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and viſcidity of the blood in this ſubject: Mr. *Blair* could not determine any thing about the thickneſs of the ſkin, while recent, but as it was dry, it appeared by an inciſion made upon one of the hips, not to be $\frac{1}{4}$ of an inch, and of a ſubſtance not unlike *Engliſh-bend*, or ſole-leather: He had no opportunity of obſerving, whether there were any cutaneous veſſels, but he doubts not but that there were, and that very numerous. 1. From the many glands diſperſed all over its inner ſurface, which muſt have blood-veſſels inſerted into them, and 2. From the many ramifications diſperſed in the *cuticula*, proportionable to which, it is probable, they were likewiſe in the *cutis*: Mr. *Blair* can ſay nothing about the *Panniculus carnoſus*, nor is he fully ſatisfied with what is related by Dr. *Moulins*, *viz.* That this animal kills the flies, by ſuddenly wrinkling or contracting the ſkin on that ſide, which is attacked by them; ſo that the cracks or rents are forced cloſe together, and the flies cruſhed; for it is hard to conceive, how ſuch a large animal ſhould, all on a ſudden, be ſo nimble; Mr. *Blair* rather thinks, that the *Proboſcis* from before, and the tail from behind, ſupply the want of the *Panniculus carnoſus*; for if we conſider the length of each, we ſhall find that they come near to meet about the middle; for the body of this ſubject being 10 foot in length, the *Proboſcis* and tail make up between them, near nine foot of it; and the air, by the force of their motion, is ſufficient to drive away the flies, even when out of their reach: As to the fat, whether the want of it might be owing to the exceeding leanneſs of this ſubject, or whether it be common for elephants to have but little thereof, Mr. *Blair* does not know; but he could not have thought, that there had been ſo little fat in any animal, as in this; for beſides that there was neither a *Membrana adipoſa*, nor *Omentum* to be ſeen, there was not the leaſt fat, either among the interſtices of the muſcles, or about the kidneys, nor round the *Anus* and *Vagina*, where it is uſually found; and what was more, when he had ſpent near a whole day in boiling the bones in a dyer's copper, without changing the water, only that he ſupplied what was evaporated, there was not ſo much as a drop of oil to be ſeen ſwimming upon the liquor: Dr. *Moulins* takes notice of a very ſtrong nervous membrane, which deſcended obliquely from the *Spina dorſi* to the *Sternum*, and *Linea alba*, this membrane, he obſerves, was very tough, and near as hard to be cut, as whalebone of the ſame thickneſs; all along the back it was about $\frac{1}{6}$ of an inch, but the nearer the extremity, he found it the thinner; this membrane ſeemed to terminate in the *Linea alba*, as the tendons of the

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muſcles of the *Abdomen* uſually do; its nervous fibres were very diſtinguiſhable, and might eaſily be ſeparated throughout their whole length; this doubtleſs, was deſigned to ſtrengthen the animal, and poſſibly to prevent the weight of the *Viſcera* contained in the *Abdomen* from diſtending the *Peritonæum*, and adjoining muſcles, ſo as to make them hang lower than was convenient; a like piece of mechaniſm Mr. *Blair* obſerved in diſſecting a porpoiſe: After the ſkin was entirely removed, Mr. *Blair* applied himſelf particularly to the muſcles of the *Proboſcis*; wherefore the body being ſupine, he firſt conſidered the neck, and the upper and fore-part of the *Sternum*, where he obſerved two pair of muſcles to ariſe ſharp and fleſhy; whereof two in the middle, from a ſmall origin, were extended into large muſcles, running ſtreight forwards, and diſtinguiſhed from each other by a white line, till they reached the point of the lower jaw, their other ſide running obliquely outwards, till they came over againſt the articulation of the lower jaw with the upper; from thence running on the lower part of the lower jaw, they returned to the aforelaid point, in ſhape not unlike the *Cucullaris* in human ſubjects, with their fibres running obliquely forwards, from this middle line towards their external part; this pair ſerved to draw back the lower jaw, and like the *Platyſma myoides*, covered all its other muſcles, with thoſe of the *Larynx*, tongue, and *Pharynx*; on the outſide of this pair aroſe two other muſcles, ſmall at their beginning, and in their progreſs paſſing in betwixt the *Os Zygomaticum*, and ſcull, adhering to the *Muſculus temporalis*, and aſcending, they run up below the *Meatus auditorius*, half way betwixt the orbit of the eye, and top of the head, where becoming very thick and round, it paſſed over a ſharp angle of the ſcull, towards the fore-head; whence deſcending from above the eye, it came, and together with its partner filled up that hollow in the *Os palati k* Pl. VII. Fig. 2, and coming ſtill lower, it formed the back part of the *Proboſcis*, afterwards the body, being turned over, Mr. *Blair* had an opportunity of ſeeing the tax-wax, mentioned by Dr. *Moulins*, which ariſes from a *Spina* in the back part of the ſcull *c* Plate VIII. Fig. 1, whence running backwards along the ſides of the ſeven *Vertebræ* of the neck, it terminated betwixt the ſixth and ſeventh *Vertebra* of the back, becoming ſtill thinner in its progreſs; it was about ſix inches broad, pretty thick, and deſcended obliquely from the top of the *Spinæ vertebrarum* to above the ribs, and covered all the muſcles, which ariſe from the neck, and ſupport the head, aſſiſting them, as Dr. *Moulins* rightly obſerves;

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observes; because the heads of quadrupeds, especially of this animal, being more pendent, have more need of supporters, than a man's head, where this contrivance is wanting: Dr. *Moulins* tells us, that it was placed edgeways; which Mr. *Blair* supposes, may be owing to the spines of the four first *Vertebræ* of the back, which are four inches broad; whence the tax-wax, running forwards (where the spines are narrow, or where there are no spines at all, as in the three first *Vertebræ* of the neck) in a streight line to the scull, the space below it for the muscles to move in must be the same at the neck, as at the *Spine*, where the *Epiphyses* keep their superior sides, at such a distance; above this tax-wax in the neck, arise two muscles thinner and narrower at first, but thicker and broader, as they tend to the scull, where they firmly adhere to the sides of a large *Sinus* in its back part *b* Pl. VIII. Fig. 1, whence ascending, and being lodged in the depression upon the top of the head, and betwixt the eminencies *d d* Pl. VII. Fig. 2, they descend, till they come over against the hole for the root of the trunk *a*; and become thicker and round, in their whole descent form the fore-part of the trunk, with the extremity: Thus then the *Proboscis* is composed of two pair of muscles; one of which forms its back part, which arises from the *Sternum*, and passes with streight fibres below the *Os zygomaticum*, and from thence forwards, till it forms the body of the trunk itself; the other pair, which arises from the neck, passes over the head, and descending forms its fore-part; the fibres of this muscle descend in a streight line, till they form the body of the trunk, and then there begins a strong tendinous interstice, by which they are separated, on each side, from their co-partners; whence, their fibres descend obliquely to another strong interstice; by which they are separated on each side from their antagonists; where the same oblique course of fibres is again to be observed, that is, the *Erectores* of the *Proboscis* (for so we may call those, which form the fore-part thereof) *g g* Pl. VIII. Fig. 22, unite in a tendinous interstice *h*, from whence the fibres on each side descend obliquely; so likewise the *Retractores* of the *Proboscis*, for so we may call those, which form the back part thereof, have their tendinous interstices, running down along the middle of its back part; from whence, the fibres descend obliquely, forming on each side an angle almost of a *Demi rhombus* in another longitudinal tendinous interstice, whereby the fibres of the antagonist muscles are conjoined; thus we see a surprising contexture of four muscles, contrived in such a manner, as to perform all kinds of motion; for as either in the *Femur*, or

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Humerus, there proceeds a circular motion, from flexion, extenſion, adduction, and abduction; ſo here, when the *Elevator* and *Depreſſor*, or *Detractor* act together on either ſide, then there is a lateral motion; and when the congener *Elevatores* and *Retractores* act, then there is either an elevation or depreſſion produced, and from theſe two, with lateral motions on both ſides, performed ſucceſſively, there proceeds a circular motion; but this is not all, for any part of the trunk, either root, or extremity, or both at once, may be bent either upwards or downwards, and this Mr. *Blair* ſuppoſes to be performed in this manner: Theſe fibres, thus obliquely ſituated, are divided into ſeveral *faſciculi*, ſeparated by ſeveral tendinous interſections, and at the beginning of each interſection, there is a conſiderable branch of a nerve inſerted from the *Portio dura*, by which, one, two, or more of theſe *faſciculi* may be put in motion, without any other part of the *Proboſcis* being concerned: Dr. *Moulins* calls the *Proboſcis*, a *prolonged noſe*, both from its ſituation, and uſe in ſmelling and breathing; and Mr. *Blair* thinks he may with good reaſon make an analogy betwixt it, and the tongue; for beſides that there is a great affinity betwixt the ſmell and the taſte, ſince what is unpleaſing to the noſe, cannot but nauſeate the tongue and palate, inſomuch, that the noſe may be called a *taſter* to the taſte; they likewiſe agree in this animal, becauſe of the diverſity of motions in both, and the few muſcles that perform them; as it is thus elegantly deſcribed by *Bellini*; this *Proboſcis* or tongue is extended and contracted, dilated, and exerted, raiſed, and depreſſed, and bent; ſometimes it forms itſelf into a concave, and anon into a convex, it is ſometimes doubled, and again expanded, and at other times it vibrates: And *Schotto*, *Mirab. Animal. terreſt. lib.* 8. gives a brief deſcription of its motion; he turns it round every way, and that with the greateſt quickneſs; by it he takes in his meat and drink, and conveys them into his mouth, hence it is called *manus naſuta*; he erects and offers his *Proboſcis* to his rider for him to mount; with it he levels trees, and when he plunges it in water he holds it erect, and by it he reſpires: And farther, as the *Geneogloſſi* exert the tongue, by lengthening their fibres from the fore and inner part of the lower jaw, whence they ariſe to the root of the tongue, where they are inſerted; ſo the *Levatores* of the *Proboſcis* do in like manner exert this too, by lengthening their fibres from the *tax-wax*, all along the top of the head to the root of the trunk; and as the *Retractores* of the *Proboſcis* may very well perform the motions of pulling it in, analogous to the *Stylogloſſi*, to the two

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antagoniſt muſcles on either ſide may pull it to the oppoſite ſide, that it may perform the actions of the *Ceratogloſſi*, while the congener *Retractores* may put it to the ſame ſide where they act; when Mr. *Blair* ſays, that the fibres from the fore and hinder part deſcend obliquely from the tendinous inſertions at the middle to thoſe at the ſide, he does not mean, that they run ſimply ſo, but that the fibres of each muſcle are diſpoſed into different *Strata* or layers, and that theſe *Strata* interſect each other, like lozenges, or as we ſee the fibres in the oblique aſcending muſcle interſect thoſe in the oblique deſcending muſcle of the *Abdomen*, and ſo on; that is whereas, one ſeries of fibres ſeems to deſcend obliquely, the next underneath that aſcend again, and ſo continues, throughout the whole thickneſs of each muſcle: As to the circular fibres mentioned by Dr. *Moulins*; Mr. *Blair* did not obſerve any, neither does he think them neceſſary for pulling up the trunk, or ſhortening it; for the great diſtance between the origin of theſe muſcles, and their inſertion at the extremity of the trunk, the longitudinal poſition of their fibres, till they come to form a part thereof, and the ſpace they have to act in, and ſwell their bellies, and their oblique inſertion into theſe tendinous lines, may be looked upon, as ſufficient to perform this motion; and it is obſervable, that for this purpoſe, the ſkin is divided into ſeveral *Plicæ*, or links, as we ſee in a worm, when ſhe contracts heſelf; thus Mr. *Blair* ſuppoſes, that the *faſciculi* may at their origin begin to be very much contracted, then the *faſciculi* next to them, and ſo on, till they come to the root of the trunk; by which ſucceſſive contractions, the bellies of all the muſcles begin to ſwell, and ſo their fibres are ſhortened; and there needs no more for extending the *Proboſcis*, thus contracted than that the fibres reſile to their former poſition, which may be done with the ſame ſwiftneſs, as a bow does by its elaſticity, when it is ſhot off: Theſe muſcles ſurround two large cavities, about the middle of the *Proboſcis*, two inches in diameter from the right to the left, and each three inches from the upper to the lower part; for as they proceed from the ſcull, they are very wide, according to the capacity of the hole, in the fore-part of the ſcull, whence the *Proboſcis* proceeds; they are divided by a ſtrong cartilaginous *Septum*, which runs ſtrait from the fore to the hinder-part, along the middle of the *Proboſcis*; and into this *Septum* the muſcles, ſituated in the fore and back part, are inſerted; theſe holes are cartilaginous and ſpread all over with ſeveral nerves, and furniſhed with a great many glands, for ſeparating a certain *Mucus*, wherewith the

the inner ſurface is always lubricated, to keep it moiſt, and preſerve it from the injuries of the air in breathing; theſe two cavities are of great uſe, for they draw up and contain as much water as ſerves the animal at a time, which it afterwards empties into the mouth, as it were from a tunnel; they likewiſe ſerve for breathing, ſmelling, and uttering the voice; the *Proboſcis* is not equally large, but from 38 inches in circumference at its origin, it becomes gradually ſmaller, till it be no more than 20 inches at the middle, and 11 inches at the extremity; it has a hollow cartilage, where theſe paſſages terminate; round this is a cartilaginous margin, which extends itſelf an inch and a half before, and terminates in a point; and it has a hollow, as it were, behind, wherein this point fixes itſelf, and lays hold of any thing, like a thumb betwixt two fingers; this cartilage is very ſtrong, and by it the elephant can take up any great weight: In ſearching for the origin of the *Proboſcis*, and how it proceeded from the head, Mr. *Blair* ſeparated the *Levatores Proboſcidis*, below which he obſerved four conſiderable blood-veſſels, a vein, and an artery from each ſide, lying upon and deſcending in a ſtrait line over the above-mentioned cartilages, and ſpreading their branches every way throughout the ſubſtance of the muſcles, with two large nerves accompanying them; about their origin, which he had not time to trace, Mr. *Blair* offers the following probable conjectures, *viz.* the external carotid artery, which furniſhes blood to the muſcles of the face, and lower-jaw, has already undergone ſo many diviſions and ſubdiviſions, in the vaſt maſs of large muſcles in this animal, that it is not probable, there ſhould ſtill remain a branch ſo large, and which ſhould have ſo ſtrait a courſe, as to be thus diſtributed in this part; and the capillaries of the external jugular, are uſually diſperſed in ſuch a manner, throughout the extreme parts, whence it receives the blood, that it is not to be ſuppoſed, they ſhould ſo ſoon form ſuch conſiderable branches, and theſe again unite into one trunk, at ſuch a diſtance from the baſis of the ſcull, where the two jugulars are conjoined; and beſides the ſituation of the carotid artery, and jugular vein is ſo low, and thoſe branches Mr. *Blair* obſerved ſituated ſo high, that he could ſcarcly think, the one proceeded from the other; it remains then to enquire from whence they ariſe: It is obſervable both in human ſubjects and in quadrupeds, that there is a hole below the orbit of the eye, in the bone of the upper-jaw, thro' which the ſuperior branch of the ſecond diviſion of the fifth pair of nerves paſſes, in its progreſs ſurrounding a vein and an artery; all which are diſperſed in the muſcles of the cheeks,

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cheeks, lips and noſe, and furniſh branches for the roots of the teeth of the upper jaw; this hole is not ſo conſiderable in human ſubjects, but larger in quadrupeds, eſpecially, ſuch as feed on graſs or hay; inſomuch, that by the largeneſs of this branch of the fifth pair in an ox, or hart, we may reaſonably conjecture, that they have a partial taſte, and a moſt acute ſenſe of ſmelling by the upper lip, the better to enable them to chuſe their food; for in diſſecting a calf's head, one may perceive both this nerve, and the blood-veſſels much larger, than what might be thought neceſſary for furniſhing either blood or ſpirits to this part, were there not ſome extraordinary uſe for both: Now in this ſubject, there is a *Foramen* in the bone of the upper-jaw (as repreſented by *r r* Pl. VII. Fig. 2, by *m*, Fig. 3. and by 88 Fig. 4) ſo remarkable for its bigneſs, ſo commodiouſly ſituated, and ſo well guarded, that Mr. *Blair* thinks, he had good reaſon to believe, that it might be deſigned for the tranſmiſſion of the above-mentioned artery, vein and nerve, and that all theſe are diſtributed into the trunk; for if we conſider the largeneſs of the *Foramen* for this branch of the fifth pair, as it is to be ſeen in the inner ſurface of the baſis of the ſcull, Fig. 5. whoſe capacity is ſuch, as to contain a nerve of about twice the bigneſs of what Mr. *Blair* ſuppoſes it to be; and again, if we conſider the *Crena*, or ſlit *x x*, which paſſes between the *Foramen*, for the ſecond branch of this fifth pair, and the third branch *i i*, and how the *Foramen* for the artery of the *Dura Mater k k*, is only ſeparated from the *Foramen* for the third branch *i i*, by a ſmall bony *Septum*, we may ſuppoſe, that this artery of the *Dura Mater* enters, where the third branch of the fifth pair goes out, and ſends up one branch *k k*, which immediately enters the *Dura Mater*; and another branch, which runs forwards in this *Crena*, to the *Foramen* for the ſecond branch of the fifth pair *h h*, and goes along with it, and paſſes out below the *Lamina*, which forms the upper part of the *Sinus* 2, for the orbit of the eye S, and runs forwards along with the ſecond branch to this large oval *Foramen*; where after it is come, it aſcends obliquely in a *Crena*, to be ſtill ſeen in the bone, till it reaches the root of the *Proboſcis*, where it is ſpread as above; and the vein, returning by the ſame *Foramen*, runs along with the other two, tho' it does not enter the ſcull; but running backwards, paſſes in below the aforeſaid *Lamina*, and deſcends where the artery of the *Dura Mater* aſcends; Mr. *Blair* could not poſitively determine the capacity of theſe blood-veſſels, at the root of the *Proboſcis*; but they were conſpicuous, and could admit of a gooſe-quill tho' empty; and

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when full, he doubts not, but they were upwards of twice the bigneſs: This extraordinary part had alſo a ſufficient number of nerves; as, 1. The obfactory nerve, whereby it is endued with a very acute ſenſe of ſmelling. 2. The aforeſaid ſecond branch of the fifth pair, which accompanying the blood-veſſels, is with them diſperſed throughout the whole ſubſtance of the *Proboſcis*; and by which it has ſo acute a ſenſe of feeling, wherewith this part is more ſignally endued, and whereby it avoids whatever is noxious to it; as appears by the inſtance given by Dr. *Moulins*, who tells us, that ſuch was the care of that ſubject he treats of, for his *Proboſcis*, that he thruſt it two foot deep into hard ground, to preſerve it from the fire. 3. The hard portion of the *Nervus auditorius*, which tho' diſperſed in the muſcles of the face in human ſubjects, yet in quadrupeds, ſuch as oxen, it continues undivided, till it reaches the angle of the lips; and here Mr. *Blair* traced it a pretty way, as it run forwards above the temporal muſcle, a little below the ear, till it came to the upper-lip; whence it proceeded to the above-mentioned tendinous interſtice, which runs down on each ſide of the *Proboſcis*, ſending a branch to each of the *Faſciculi* of fibres already mentioned; this ſeems to be chiefly adapted for the different motions of the *Proboſcis*; for as we obſerve in the *Muſculus rectus* of the *Abdomen*, that at each of the tendinous interſtices, whereby its fibres are ſeveral times collected together, a nerve enters at the beginning of each *Faſciculus*; ſo here the muſcles of the *Proboſcis* being divided into ſeveral *Faſciculi*, each of them had a branch of this nerve diſperſed therein; and this nerve is ſituated on each ſide, that it may the more conveniently ſend its branches alternately, both to the *Faſciculi* of the *Elevatores* and *Retractores*; and both the ſituation of this nerve analogous to that in other quadrupeds, and its contexture ſufficiently proved, that it was no other than the *Portio dura*; it was indeed an agreeable ſight to obſerve its ſtructure, how ſeveral ſmall fibres were knit together into one bundle, and ſeveral of theſe again involved by common *Membranulæ* formed different *Faſciculi*, till at length all were included in one common integument; Mr. *Blair* could obſerve no cavity in the fibres, tho' he viewed them thro' microſcopes; as they paſſed thro' the bone, the *Faſciculi* adhered more cloſely to each other, whereby the nerve poſſeſſed a leſs ſpace; but no ſooner had they paſſed it, than they began to be more looſely conjoined within the common integument, whereby the whole nerve appeared bigger; The *Proboſcis* is the principal ſeat of two of the ſenſes, and partially partakes of the third, for, by it the animal ſmells, by it

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feeling is performed, as by the hands in us, on which account it is not improperly called *Manus naſuta*, and by it the fifth pair of nerves affords a partial ſenſation of taſte; it has alſo a great analogy with the other two ſenſes, the eye and the tongue, with the former by its three pair of nerves, namely, one for ſeeing, analogous to the other for ſmelling; one for its pathetical motions, analogous to the acute ſenſation, afforded to the other by the fifth pair, and one for the motion of its other muſcles, analogous to the *Portio dura* of the other; and with the tongue, as has been already ſhewn at large, by its different motions, and by its partial taſte: Mr. *Blair* cauſed the *Abdomen* to be opened lengthwiſe, whereupon the inteſtines jetted out in a confuſed maſs; firſt the paunches or tripes (being not unlike the *Omaſum* and *Abomaſum* of an ox) and then the thinner guts; the figure Dr. *Moulins* gives of a part of the *Colon* and *Rectum*, ſeems to be pretty juſt; and Mr. *Blair* found that they were about half a foot in diameter: He next extracted the *Uterus*, with the *Cornua*, *Ovaria* and part of the *Ligamenta lata*, as repreſented by *a a*, Pl. VIII. Fig. 20; it was not unlike the *Uterus* of ſuch animals, as bring forth ſeveral at a litter; for upon inflating it, he perceived ſeveral protuberances *e e* to ariſe, as if they had been ſo many cellules, ſuch as bitches, cats, hares, *&c.* have for containing the ſeveral *Fœtus*'s with their proper *Placentæ* and *Involucra*; which might have been a ſufficient proof, that they bring forth more than one at a time, had not authors affirmed the contrary; for whereas the *Uterus* of ſuch, as bring forth only one at a time, is proportionably large, and the *Cornua* ſmall, here the body of the *Uterus c* was very ſmall, and the *Cornua f f* ſwelled on each ſide, by inflation, leaving a *Sulcus d* in the middle, and theſe different protuberances aroſe with depreſſions, like ſo many interſtices between them; this furrow *d* ſeemed to Mr. *Blair* to point out the *Septum*, whereby the *Cornua* were divided from each other, and theſe interſtices to denote ſo many membranes, as it were, whereby theſe protuberances were bounded, and formed into cellules, communicating with each other; theſe protuberances *e e* were regularly diſpoſed, there being two or three on each ſide of the *Septum*, and tho' ſome of them were obliterated, yet the veſtiges of others ſtill remained obvious in the dried *Uterus*: Each of the *Ovaria* was as big as a large apple, with the *Ova* diſtinguiſhed by their proper membranes; being for the moſt part, about the bigneſs of a ſmall pea, and all involved within a common, thin, and pellucid tunicle, thro' which they ſhone; they were provided with a looſe, thick, wrinkled tunicle *i*, for their defence, which he could remove at plea-

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ſure, it no ways adhering to the *Ovaria*, but fluctuating on them, and proceeding from the *Cornua g*; he opened one or two of theſe *Ova*; and found them filled with a thin limpid matter, not unlike *Hydatides*, but that the humour was more viſcous, which evoporated in the dried *Uterus*, and the *Ovaria* quite collapſed; the extremities of the *Cornua*, that received the *Ova* were very narrow; for upon inflating the *Uterus*, it retained the air for ſome time, without letting it paſs immediately by the *Cornua*; tho' afterwards when he tied the *Vagina* cloſe, he obſerved that the air eſcaped inſenſibly, and now and then he could ſee ſmall bubbles ariſe towards the *Ovaria*; he could not obſerve any fluctuating *Alæ Veſpertilionum*, nor *Morſus Diaboli*; but he ſuppoſes, that the *Ova* are received into the extremities of the *Cornua*, by an *Hiatus*, below the looſe *Involucrum*, which was ſaid to defend the *Ovaria*; the *Vagina b*, was very ſmall and narrow, not admitting above two or three fingers; its inner ſurface was whitiſh, and moiſtened by a certain kind of *Mucus*, and all full of *Plicæ*, or wrinkles: The bladder was rounder than that of an ox, and much larger than Dr. *Moulins* would have it; for he affirms, that it is much about the ſize of an ox's bladder; but Mr. *Blair* found, when it was inflated, that it might contain ſix or ſeven *Engliſh* gallons, and he does not doubt, but that it might have been inflated to a greater degree, had he had the proper inſtruments; it was indeed very ſtrong, and the veſſels appeared very prettily diſperſed thro' the tunicles, which he could have eaſily ſeparated; the ureters were about half an inch in diameter; both the *Uterus* and bladder were involved in a duplicature of the *Peritonæum*, ſo that he ſeparated them with much difficulty.

Dr. *Moulins*, in ſearching for the *Teſtes*, in the male elephant he diſſected, found two muſcles very like them, and which he took for them, till he had traced them to the inner and lower-ſide of the *Iſchium*, where he found them inſerted; he alſo traced the tendons, and found, that when they had gone ſingly for about four inches, they united and went directly under the middle of the *Penis*, and reached beyond a curvature he obſerved therein; it was about eight inches long, and terminated within ſix or ſeven inches of the glans, expanding itſelf into a membrane; beſides theſe, there was a nervous body, that aroſe underneath, near the aforeſaid tendons, about eight inches from the root of the *Penis*, and reached (diſtinct from it) nine inches before it was inſerted again therein, at a place five inches and a half from the glans; the Dr. is of opinion, from the poſition of theſe muſcles, that the

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elephant is a retromingent, and probably a retrocoient animal; and what confirmed him in that opinion was, the curvature of bending downwards he obſerved in the *Penis*, ſomewhat ſhort of the end of the tendon; and that he was told, when the elephant would make water, he was obſerved to unſheath the *Penis*, and bend it backwards, and ſo diſcharge the urine between his legs outwards: On this Mr. *Blair* makes the following remarks; *viz.* that admitting there were *Retractores Penis*, it is probable that there muſt likewiſe have been *Erectores*. 1. Becauſe it is requiſite, that the *Penis* of the elephant be freed from this retraction; that as it is retracted *in Mictu*, ſo it may be brought forwards *in Coitu*. 2. Becauſe it is requiſite, that the *Penis in coitu* be brought (if not altogether) yet obliquely upwards; as we ſee when a horſe makes water, he firſt unſheaths the *Penis*, which declines by its own gravity, and if aſſiſted by a more than ordinary ſupply of ſpirits tends a little forwards; but in an elephant there is always a ſupply of ſpirits requiſite in making water, both to cauſe the *Penis* to penetrate the ſheath (whoſe inner orifice, as Dr. *Moulins* affirms, were ſhut ſo cloſe, that it would not admit a man's little finger, ſo that he was obliged to divide it, before he could come at the *Penis*) and endue it with a certain rigidity, and ſwell the *Retractores*, whereby the *Penis* becoming a little ſtiff, may be drawn back; ſuppoſing then, that there are ſuch *Erectores Penis*, we muſt likewiſe ſuppoſe them to be of a far greater force and bulk, than the *Retractores*; for if, according to the Dr. the *Penis* at making water be retracted far beyond the uſual poſition of the *Penis* in other animals, we may likewiſe ſuppoſe it to be endued not only with antagoniſt muſcles to theſe *Retractores*, whereby the *Penis* may be brought to ſuch a poſition, as we obſerve in horſes, but alſo be made to aſcend, ſo far as is requiſite for coition; beſides it is to be remarked, 1, That the *Vagina* is not placed behind, a little below the *Anus*, as in a mare, but below in a direct line with the reſt of the belly, on which account the *Penis* muſt neceſſarily aſcend. 2. The *Oſſa innominata* aſcend obliquely, which muſt cauſe the *Penis* to do ſo too. 3. By the Dr's own account of the *Penis* (for he affirms, that it is bigger, but not ſo long as that of a horſe) it can hardly be ſuppoſed both to bend backwards, aſcend again, and enter the *Vagina*, ſo far as is requiſite.

Dr. *Moulins* affirms, that the *Teſtes* were not contained in a *Scrotum*, or *Capſula*, but that they lay in the *Perinæum*, cloſely joined on each ſide to the *Penis*, that they were neither of the uſual ſhape, nor bigneſs, nor included in a proceſs of the *Peritonæum*,

zonæum; that their ſhape very much reſembled that of a cheſnut; and that they were thicker on the ſide next the *Penis*, than on the oppoſite; that they were flat and round, and not proportionable to the other parts of his body, weighing no more than about three or four ounces; that they were joined to the *Penis* by, at leaſt, 100 ſeminal tubes, which might be properly called *Vaſa deferentia*, and which depoſited the elaborated *Semen* in ſeveral rhomboid cells, in the body of the *Penis*, which in this animal, was the common and only repoſitory, where the *Semen* could be found; theſe cells were turgid with *Semen*, and ſo were the tubes; the latter were very large, admitting a large pin, or upwards of an inch, when the tube was ſtreight, as moſt of them were; but being traced farther into the body of the *Teſtes*, they became ſmaller and ſmaller, till at length they diſappeared; the blood was conveyed into the *Teſtes* by the *Vaſa deferentia:* The Dr. as he proceeds is a little perplext in his account, which take in his own words; tho' theſe were ſmall, and diſproportionable, yet he took them to be the *Teſtes*, nothing elſe appearing outwardly, that contained ſeminal veſſels, till he was told by Dr. *Needham*, that his deſcription of the *Teſtes* of an elephant agreed with the *Proſtatæ* of a bear; upon which he miſtook the *Teſtes* for the *Proſtatæ*, there being a great reſemblance between theſe animals; and having found two ſubſtances between the kidneys, and neck of the bladder, which might very well be *Teſtes*, and which till he diſcourſed that ingenious gentleman, he did not know what to make of, and then he proceeds; the *Venæ preparantes* were large; he divided lengthwiſe that which was inſerted into the emulgent, and within a little more than an inch of its inſertion he found about 8 or 10 valves of divers ſhapes, all fitted to hinder the return of the blood into the variouſly divided ſpermatic vein, which here from 8 or 10 ramifications became one large veſſel; within about an inch of this, and ſomewhat more than two inches from the kidneys, he found a ſubſtance of the ſhape of a pear, but near three times the bigneſs of a very large one; but he could not tell what to make of it; what he obſerved therein was, that the ſpermatic veſſels entered but a little way into it, but below its middle he found them more deeply placed, and their branches become ſo ſmall, and leſs numerous to the naked eye, as if here the veins began; the inner part of this ſubſtance looked of a paleiſh, but ſomewhat muddy red colour; it was very ſpongy, not much more compact than the lungs of a young animal; the Dr. doubts not, but this ſubſtance was deſigned to prepare the *Semen*; but by what veſſels it

was

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was conveyed to the *Penis*, or any other repoſitory (itſelf containing none) he could not diſcover, nor could he find any peculiar veſſel, or duct, or any thing that reſembled that above-mentioned ſubſtance, by which he might be directed in his enquiry; it lay lengthwiſe from the kidney to the *Teſtes*, with the largeſt extremity loweſt; the Dr. is of opinion, from what he heard from Dr. *Needham* about thoſe parts, that theſe two pear-ſhaped ſubſtances, were *Teſtes*; their place, ſize, figure, and the accidental cutting of the *Vaſa deferentia*, being the occaſion of his former ignorance in this point: The Dr. could obſerve no *Veſiculæ ſeminales*, nor any common receptacle for the *Semen*, excepting the above-mentioned rhomboidal cells in the *Penis* itſelf, but he did not doubt, but that there might ſtill be ſome: Thus he acknowledges his miſtaking the *Teſtes* twice, and leaves them in doubt the third time.

Mr. *Blair* carefully extracted the liver entire, and he is apt to think it had no membrane inveſting it, as Dr. *Moulins* affirms; and that the membrane mentioned by the Dr. was nothing other than the proper tunicle of the liver, raiſed by the fire, as ſhall be ſhewn hereafter; the liver in this ſubject was 56 inches long, and 22 inches at the broadeſt part; he found no *Veſicula felliſ* therein; both the *Vena cava* & *Porta* were very large, and had their exit and entrance in the concave part of the liver; the liver had only one lobe, but both the veins diſperſed themſelves, firſt into two large branches, and then were ſubdivided there, as in the ordinary manner; Mr. *Blair* opened ſeveral of them, and found them differ in nothing from thoſe in other animals, the ſubſtance being firm, as uſual, and the glands large, and conſpicuous; the external ſurface ſmooth, and its proper tunicle firmly adhering to the glands, all which is repreſented in Plate X. Fig. 5.

Dr. *Moulins* affirms, that the membrane that inveſted the liver, was raiſed therefrom a conſiderable way; tho' this membrane ſeemed to be entire, and looked like the *cuticula* raiſed by a bliſter, yet it contained no *Serum*; and where it ſeemed to be intimately joined to the liver, it came off by a gentle pull, without tearing, as if it had been faſtened, but very ſlightly thereto, or rather as a bag, that contained and exactly fitted it; the Dr. takes the uſe of this to be chiefly to terminate the capillary veſſels, and prevent the gleeting of ſerous humours; and concludes, that he muſt entirely impute this to the fire: By all which, this ſeems to be no ways different from the proper membrane Mr. *Blair* obſerved: The bile, according to Dr. *Moulins*, was depoſited

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sited at the end of the first gut, four inches and a half below the *Pylorus*; from whence he traced the *Ductus communis* to the liver, in order to find the gall-bladder; but it was wanting, and instead thereof he found the *Porus bilarius* proceeding from the liver, as the *Ductus hepaticus* usually does; he likewise observed that the bile found therein, differed both in colour, and consistence from that in the *Ductus hepaticus*; for the latter was of a clear, light yellow colour, congealed like a jelly, and the former of a dark green colour, and somewhat more fluid than the gall of an ox: The *pancreas*, Dr. *Moulins* observed, was very long, and large; for it reached from about the middle of the stomach to the *Jejunum*, which space could not be less than six foot; it was of the conglomerate kind, as the *Pancreas* always is, and its duct was so wide, as easily to admit one's little finger; it opened into the gut, where the *Ductus felleus* did; whether both the passages joined in one, before their aperture into the intestines, the Dr. could not tell; the *Succus* in the duct was not limpid, as it usually appears, but of a very dark green colour, and yet very fluid, seeming to contain no viscous phlegm.

The spleen in Mr. *Blair*'s subject was three foot and ½ long; its edge on the back part was somewhat incurvated, almost resembling an unbent bow; on the fore-part it enlarged itself by degrees, from a narrow point at each extremity, till it came towards the middle, where the vessels entered, and where it was broadest; the splenic vein was thin and flaccid; what blood was squeezed out of it was blacker than any he observed throughout the whole body; he cut off a little of it, and squeezed venal grumous blood out of several of its cellules; it was in breadth from three inches towards the extremities, to eight inches about the middle.

The *Glandulæ renales* were placed in the usual manner; they were about five inches long, two inches broad, and of an oval form, and sheathed with a loose external membrane, which contained the divided into several lobes, like the kidney of an ox; from whose gland itself interstices there went out several thin membranes, which passing to the loose sheath kept it fast, and by which alone the sheath adhered thereto; cutting the gland lengthwise, he found a cavity therein, capable of containing about two ounces, quite full of black grumous blood, in colour much like that in the spleen; it is probable, that as the spleen is to the liver, so the *Glandulæ renales* are to the kidneys; that is, whereas the blood after it is distributed into the intestines, by the several arteries that proceed from the *Aorta*, is received by the orifices of so many

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many veins, as serve to form so many roots of the *Vena porta*, it is convenient, that this blood should be animated by a new supply of spirits, the better to enable it to continue its circulation in the *Porta* thro' the liver, and dispose it for the better secretion of the bile; for which use the spleen seems to be adapted, both from its situation, in respect of the liver, from its structure, from the *Mora* of the venal blood, after it is discharged from the arteries, and from its being furnished with a considerable branch of a nerve; in like manner the kidney being a *Viscus*, where there is a vast secretion of *Serum*, these *Renes succenturiati* seem to be designed for furnishing a new supply of spirits to the venal blood, after it has passed the kidneys, and undergone this secretion; both which uses may appear from their structure.

The kidneys were of a large, and proportionable size, being a foot long, and ¼ a foot broad, and of the usual shape much like that of a man; their external surface was smooth, and level with their external coat, which closely adhered to its internal substance, without any lobes externally discernible; but after opening one of them, he perceived six large urinary caruncles; its substance was very obvious, and corresponding to the structure, usually observed in the kidneys; *i. e.* the glandulous substance was externally very conspicuous, for the space of about ¼ an inch in circumference; then began to appear the urinary *Tubuli*, first smaller, and less obvious; then another series larger, and a third still larger, till they began to surround each of the caruncles, like so many rays; Mr. *Blair* could not see so clearly with his naked eye, the coalition of the smaller *Tubuli* into the larger ducts; but, as it happens in all these excretory vessels, they did not appear branch'd, and divaricated, as blood-vessels usually are; but continu'd parallel to each other, till from the smaller to the larger vessels, they at last emptied themselves into the common receptacles; he could not be positive, whether there was one common *Ureter*, into which all the six caruncles emptied themselves, or whether each had a particular branch of an *Ureter* into which they were discharged; only he observ'd no *Pelvis*, which happens for the most part, where the caruncles are very large: In general, Mr. *Blair* observ'd, that the flesh of this animal was for the most part so tough, that no launcet, how keen or strong soever, could do any service, wherefore he was obliged to make use of butcher's knives.

There was scarce any thing remarkable in the *Thorax*, only the *Viscera* here were large and strong; one of the lobes of the lungs had nothing observable, but its bigness, which was proportionable enough; it did not adhere to the ribs, as in Dr. *Mou-*

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Dr. *Moulins*'s ſubject, but lay flaccid on one ſide of the heart, as the other lobe did on the other ſide; ſo that Mr. *Blair* looks on this adheſion, mentioned by the Doctor, to have been in a morbid ſtate; between the two firſt ribs, Mr. *Blair* obſerved two large glands, one ſituated on the outſide of each of the *Carotids*, as they paſſed out of the *Thorax*; they were round, and near as big as a turkey's egg, each having a conſpicuous artery inſerted, and a vein paſſing from them; theſe he took to be the *Thymus*, which, tho' ſeldom obſerved in adult ſubjects, yet, perhaps, may be ſeen at all times, in ſuch a large animal as this; he cut off one of them, with part of the adhering artery, and he could obſerve nothing upon opening it, but ſeveral looſe thin membranes on the outſide, which, he ſuppoſes, might have ſupported, and contained in the cavity, (whoſe ſides they form as they run to and fro) a great deal of fat, when the animal was in good condition, and a firm glandulous ſubſtance in the inſide, without any cavity; their veſſels were proportionable to their bigneſs, but he could determine nothing, as to their uſe; he traced one of the branches of the *Aorta Aſcendens* down to the heart, and cutting it above, he was ſurprized to ſee a fatty ſubſtance jet out of it; and pulling it, he extracted a *Polypus*, upwards of two feet in length, adapted to the capacity of the artery, which was about two inches and $\frac{1}{4}$ in diameter; this *Polypus* was no ways fibrous, but ſo much fat moulded, as it were, in ſuch a manner, not unlike the blade of a broad ſword, near $\frac{1}{4}$ of an inch thick at the middle, and much thinner at the edges; tough and flexible, with ſome grumous blood, and not ſo compact at the extremity.

When he came to the heart, he ſaw all its veſſels very large, the *Bivium Aortæ* very thick and ſtrong; there was nothing remarkable about the heart, excepting its bigneſs, which was proportionable to the body; the auricles were large, and the left, as well as the right auricle, full of grumous blood: Upon opening the ventricles, he found them both filled with the ſame *Polypus*, which had ſtrangely twiſted itſelf in amongſt the valves, both the *Tricuſpides* and *Semilunares*, and likewiſe amongſt the fleſhy columns, at the bottom of each ventricle, which here ſeemed to be ſo many ſmall, ſtrong, round muſcles, ſome $\frac{1}{4}$ of an inch, others $\frac{1}{2}$ an inch, and ſome again near an inch long, with a round fleſhy belly, and two tendons, variouſly ſituated, as may be ſeen in the hearts of other animals; theſe *Polypus*'s, from a maſſy ſubſtance, in the middle of the ventricle, emitted their branches

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to all parts, and here and there twisted themselves with surprising intricacy, round these fleshy columns, their tendinous insertions, and the tendinous fibres of the valves; in short, there was no angle nor cavity, which the *Polypus* did not fill; and yet it was so much disengaged from the substance of the heart, and so strong and tough, that by pulling its thicker part in the middle, all the other branches mov'd; and by cutting a few parts of it, where it was most engaged, and where the fleshy columns were thickest, he extracted it altogether; and expanding it, it was an agreeable sight to behold these several ramifications, proceeding from its thicker part, like so many thongs or laces, into which a piece of leather is cut, some broader and some narrower, but none very thick, of a yellow colour and fatty substance, and each of them weighing a pound, which was more fat than was upon all the body besides.

The mouth of this animal is very small and narrow, in proportion to the body; and that on these following accounts: 1. Because neither the lips nor the teeth are employed in gathering the food, as in other quadrupeds; so that the mouth only serves to receive the aliment from the *Proboscis*, which both gathers and conveys it into it.

2. The *Dentes maxillares* are of such a thickness, both in the upper and lower jaw, but especially in the latter, as to contribute to render the mouth narrow; nor need it be broader, because the strength of the grinders is such, as at once to comminute the aliments in such a manner, as not to require the tongue to move them to and fro in the mouth, in order to have them farther masticated, as in other animals; and therefore the tongue is small, short, and round, terminating in a point; thick, and not thin and flat, as in an ox, with a soft smooth surface, without any discernible *Papillæ*; by which it should seem not to chew the cud; all that Mr. *Blair* observed peculiar to the tongue, was the firm adhesion of the *Thyroides* to the *Os Hyoides*, both which are represented in Plate X. Fig. 6, 7. The passage, says Dr. *Moulins*, to the ventricle, was thro' a peculiar hole, near the root of the tongue, and exactly in the middle of that part, and was the beginning of the *Oesophagus*; there was no communication between this, and the passage into the lungs, contrary to what happens in other animals; for the *Membrana pituitaria anterior* reached to the very root of the tongue, below the *Oesophagus*; so that it could emit no voice by the mouth, but by the trunk; this

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membrane had several paſſages for the *Saliva*, uſually ſecreted there; between the end of the *Proboſcis* and the *Larynx* there was a *Membrana pituitaria poſterior*, which had ſeveral of the ſame ſort of ducts. This account ſeems very improbable to Mr. *Blair*; for it is well known, that the *Larynx* poſſeſſes the fore-part, and the *Oeſophagus* the hinder part, between the *Vertebræ* and *Larynx*; now, how the *Oeſophagus* can thus be ſituated, and yet have ſuch a communication with the mouth, as to hinder the *Larynx* from communicating with it, Mr. *Blair* very much queſtions: The *Aſpera Arteria*, continues the Doctor, was very large, and without an *Epiglottis*, there being no danger of any thing falling into the lungs from eating and drinking, ſeeing there is no communication between the *Oeſophagus* and it: Here Mr. *Blair* obſerves, that the difficulty ſtill remains; for how can aliments be ingeſted into the mouth, and not paſs over the *Larynx*, before they enter into the *Oeſophagus*; which ſhould imply, that the *Oeſophagus* lies before, and the *Larynx* behind, which would entirely invert all the rules of the animal oeconomy; ſeeing then, that the *Oeſophagus*, in its deſcent, muſt have paſſed in between the head and the lungs, and then penetrated the diaphragm, or otherwiſe; and after it had deſcended a little, it muſt have turned aſide, and paſſed behind the *Larynx*, as the iliac arteries do over the iliac veins; which, tho' Mr. *Blair* could not obſerve, by cutting off the head, yet he thinks it improbable; becauſe then at every deglutition, the animal would ever and anon be oppreſſed with a difficulty of breathing, by the preſſure of the *Oeſophagus* on the one ſide, and the *Vertebræ* of the neck on the other. The Doctor ſtill goes on; to the outſide of the *Cartilagines Arytænoides*, he found another grow, which was faſtened to them, but in ſuch a manner, as to be capable of moving up and down, by the help of ſome muſcles implanted therein; it was ſtrong on both ſides of the *Aſpera Arteria*; but, oppoſite to the *Oeſophagus*, or on the underſide, it was very limber; this wanted about two inches and $\frac{1}{2}$ of quite ſurrounding the aforeſaid cartilages on the upper ſide, or that next the *Oeſophagus*, and ſeemed to ſupply, in ſome meaſure, the want of an *Epiglottis*, by contracting the *Glottis*, in order to prevent the creeping of animals into it; the *Cartilagines Arytænoides* formed a *Glottis* about $3\frac{1}{2}$ inches in length, and about the middle $1\frac{1}{2}$ inch broad, whoſe aperture was ſomewhat oval.

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The brain in Mr. *Blair*'s ſubject differed very little from a human brain, excepting in bigneſs, and ſomewhat in ſhape, the latter being ſomewhat oval, and the former more round; the *Dura Mater* was a ſtrong thick membrane, every where diſengaged from the *Pia Mater*, which, together with the whole ſubſtance of the brain, was much more tender, ſoft, and flaccid, than could have been expected; whether this was owing to his keeping the head two or three days, before it was diſſected, the weather being then very hot, or to the languiſhing diſtemper whereof it died, Mr. *Blair* could not determine; its ſubſtance, ventricles, and other parts, were the ſame as in other animals; the *Cerebrum* had three large productions at the *Baſis*; *viz.* one anterior, from whence the olfactory nerves proceeded, and two lateral, on each ſide of the *Sella Turcica*, reaching from the *Proceſſus Petroſus* behind, to the above-mentioned production before; upon opening the longitudinal *Sinus*, Mr. *Blair* likewiſe found *Polypus*'s therein, proceeding from the orifices, by which the blood empties itſelf into the *Sinus*.

Mr. *Blair* comes next to conſider the ſtructure, and the ſeveral parts of the bones of an elephant: The head, as repreſented by A, Pl. VII. Fig. 1. conſiſting of the bones of the upper and lower jaw, is almoſt round on its ſuperior part, having two eminencies with a depreſſion in the middle before, which depreſſion, as it runs back, becomes a deep *Sinus*; and theſe eminencies, drawing nearer each other, and as they aſcend behind, inclining obliquely forwards, are not unfitly compared by Mr. *Ray* to a man's buttocks; it is almoſt quadrangular about its middle part, being flat before, till it reaches to the root of the trunk *a*, where it is depreſſed, for the more convenient lodging of the *Proboſcis*, till it has paſſed over the mouth *b*; it is much contracted on each ſide, for the motion of the muſcles of the lower jaw *c*; it becomes very narrow at its back part, with ſeveral eminencies, *Sinus*'s, and holes; at its lower and fore-part the bone of the palate is narrow, where the *Proboſcis* hangs over; on each ſide of which are the *Alveoli* for the tuſks, and behind, the lower jaw forms all the reſt of the head; as to its external appearance, the diameter of its upper part forwards is three foot, the two eminencies *d d* fig. 2. are almoſt round, and the *Sinus e* in the middle is ten inches from the right to the left, and two inches deep; from thence deſcending five inches, the bone is flat before, and begins to form an angle on each ſide for the cavity, which contains the

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muſcles of the lower jaw and *Proboſcis*, between which angles *f f*, it is 11 inches; thence deſcending gradually, the angles tend outwards, till they come to the upper production *g g*, for the orbit of the eye, where they are 17 inches, between which is ſituated the hole *a* for the root of the trunk; this hole runs acroſs the head, being 12 inches from the right to the left, and ſeven inches on each ſide from the lower to the upper part; for in the middle it has a protuberance, where the cartilaginous *Septum* aroſe, which deſcends two inches, and terminates in an obtuſe point; within this hole were to be ſeen ſeveral of the *Laminæ h h*, whereof the cellules, that run between the two tables of the ſkull are compoſed, with the *Vomer i* in the middle, whence the *Septum* of the trunk ariſes; it is pretty thick here, and conſiſts of two *Laminæ*, with a ſpongy bone in the middle; at its upper and fore-part it communicates with the *Os cribroſum*; and you may obſerve the ſeveral perforations, thro' which a great many branches of the olfactory nerve paſs, and cover the ſurface of the cartilaginous *Septum*; at its lower and back part, where it becomes gradually thinner, it divides the *Choana*, or *Infundibulum*, into two; at the lower parr of this hole the bone becomes concave, *k*; ſo that meaſuring from the middle of the orbit of the eye, on both ſides, which are three inches and ½ diſtant, the depreſſion becomes two inches deep; at the middle of the lower part of this hole there begins a ſuture, which runs down to the extremity of the bone, *m m*; theſe two bones are articulated by *Symphyſis*; Dr. *Moulins* calls theſe *Oſſa Maxillæ ſuperioris*, but Mr. *Blair* rather chuſes to call them *Oſſa palati*; they are five inches broad at the upper part, where they are articulated by the ſame kind of ſuture *n n*, with the *Oſſa maxillæ ſuperioris*, which the Doctor calls *Oſſa malæ*; from the upper part to the lower extremity of this *Os palati*, *b*, are 15 inches; after they have quitted the *Os maxillæ ſuperioris*, on each ſide, they run down with an obtuſe angle; and being protuberant on their outer ſide, they gradually incline towards the ſuture in the middle, *m m*, forming a cavity two inches and ½ deep, at the lower extremity, which is not ſo deep as at the middle; it is deſigned for the *Proboſcis* to reſt upon, and the eminencies of each ſide are for giving room to the *Alveoli*, whence the tuſks *o o* proceed; and which are improperly called teeth, (and therefore this bone which contains them ſhould not be called *Os maxillæ*) ſince they only ſerve for a defence to this animal, and ſhould rather be called its horns; they

they are of different bigneſs in different ſubjects, and the male ſeems to have them bigger than the female; for the elephant, which was burnt at *Dublin*, had them much bigger than this which died near *Dundee* in *Scotland*; and the figure which Dr. *Moulins* gives of them, even tho' broken, ſeems to repreſent them much larger than thoſe in this ſubject; which were very ſmall, not exceeding the bigneſs of an ordinary cane, or not above an inch in diameter, and ſtreight, ſo far as they remained unbroken; ſo that Mr. *Blair* could not determine any thing about *Ariſtotle*'s aſſertion, who ſays, *Mares grandiores reſimoſque habent; fœminæ minores, & contra quam mares, vergunt enim deorſum, pronique deviant*; perhaps it might have been ſo with theſe, and that the keepers might have deſignedly broken them, that the difference of the ſex might not be known by their bending downwards or upwards; it is true, there is a great difference between the weight and length of theſe, had they been entire, and thoſe exceeding large ones, of which authors give an account: *Tenrzelius* tells us, that the length of thoſe deſcribed by him is eight feet; and he, with ſeveral others, informs us, that there are of them that weigh 100 pounds, and upwards; ſome 140, others 150, and thoſe he mentions were upwards of 100 pounds; inſomuch that *Tavernier* tells us, that in the *Indies* they make poſts of doors, and huge pales of them; and it is remarkable, which he alſo mentions, that the elephants of the iſle of *Ceylon* have no tuſks, but the firſt which the female produces; and this is confirmed by Mr. *Knox*, in his account of this iſland; *viz.* that few of the elephants there have tuſks, and thoſe only the males: Authors greatly diſpute, whether theſe tuſks ſhould be called horns, or teeth; ſuch as would have them to be horns, alledge; 1. That they ariſe from the ſcull. 2. That they are capable of a poliſh, and of being brought into any form, which it is difficult to do on teeth. 3. That they fall off, and grow again, which the teeth of no animals do, excepting thoſe of a man: Such as would have them to be teeth, tell us, that it is peculiar to ſuch animals as have the hoof divided into two, to have horns, and that horns are always cavernous or ſpongy within; whereas theſe are altogether ſolid; for tho' the firſt reaſon, *viz.* that they ariſe from the ſcull, be granted, yet it is in a different manner from horns; for they always either adhere to the skull by a certain articulation, if not cavernous, as in harts; or they have a protuberance ariſing therefrom, and filling up their capacity,

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city, if cavernous, commonly called the flint; as to the second reason, tho' it be granted, that they may be polished, *&c.* yet they are not capable of such alterations, so as to be made flexible, as horns are by boiling, or exposing them to the fire; indeed by their structure they seem to have a greater resemblance to teeth; for they proceed from the scull, and are implanted therein by *Gomphosis*; and these in this subject had cavities about two inches long, large at first in proportion to the diameter of the tusks, but as they descended, becoming gradually tapering, till they terminated in a point, analogous to the cavities in the roots of the teeth, and filled up with the same kind of substance, whereby they are kept firm in their sockets; and as to their structure, Mr. *Blair* doubts not, but that they at first consisted of a mucilaginous substance in the same manner as the teeth; and that afterwards they increase by the apposition of several *Laminæ*, or *Strata*, in proportion as the animal grows in years: Hence it is, Mr. *Blair* supposes, that *Tentzelius*'s friend came to be convinced by these *Laminæ* in the teeth, that the bones he treats of, were those of an elephant 200 years old; the *Laminæ* in Mr. *Blair*'s subject were very obvious, and the smallness of the tusks seemed to be another argument of her being young, according to their term of life: It does not matter much, whether they be called teeth or horns; for if we take their designation from their substance, they may be called teeth; and if from their use in pushing we may call them horns; and to avoid dispute, they may be called tusks, or defences; in Mr. *Blair*'s subject they ran about six inches high in the *Os Palati*, and adhered thereto by a strong ligament, as has been already observ'd.

The side of the head, descending five inches from the middle of the depression in the fore-part thereof, which is seven inches from the top of any of the eminencies, forms an angle *a*, Fig. 3, and becomes considerably depressed, where the muscle of the lower jaw, and *Proboscis* is lodged; this depression from its beginning *a*, to the *Os zygomaticum b*, (where it is eight inches and a half deep) is 14 inches and $\frac{1}{2}$, and from the fore-part *g*, Fig. 2. to the otifice of the *Meatus auditorius*, *k*, Fig. 3. is 13. inches; also from the upper protuberance of the orbit of the eye *f*, to the articulation of the *Os zygomaticum*, with the *Os temporale i*, is nine inches and $\frac{1}{2}$; the *Sinus* for lodging the eye is situated at the fore-part of this depression; for it is improperly called orbit, since only half of the part, where the eye is lodged, is bony; it has three remarkable protuberances; one at the upper, and fore-part *f*, whence a strong cartilage arises, and is inserted into another protuberance, seven inches distant (measuring obliquely)

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liquely) formed by the articulation of the *Os zygomaticum*, with the *Os maxillæ g*; and a third protuberance in the middle *e*, at three inches and a half diſtance from each of the former; this protuberance ſerves for the inſertion of the *Trochlea* of the *Muſculus obliquus major*; the bottom of the orbit has another *Sinus f*, which conveys the optic nerve to the bottom of the eye, the upper part of which conſiſts of a *Lamina* of the *Os frontis*, which lies over the *Os maxillæ*; from beneath this *Lamina* proceeds not only the *Nervus opticus*, *motorius*, and *patheticus*, but likewiſe a conſiderable branch of an artery, vein, and fifth pair of nerves; which running forwards, paſs through a large hole *m* in the *Os maxillæ*, and are diſperſed in the *Proboſcis*, of which hereafter; the *Sinus f*, whoſe lower ſide is formed by a ſpine running along the *Os maxillæ*, is nine inches long, and an inch and half broad at the middle, and an inch deep; but as it comes forwards, it is enlarged, as the globe of the eye increaſes: The *Os maxillæ* is a very irregular bone; at the fore-part of the ſcull it begins with a ſharp point *pp*, having that part of the *Os Frontis*, which forms part of the orbit *d*, Fig. 2. on the one ſide, and that part of the *Os palati*, *m*, which forms the hole for the root of the trunk, on the other; from whence running ſix inches, and inclining inwards, by a curved ſuture, it terminates in a protuberance; beneath which is a ſmall *Sinus*, aſcending obliquely to the hole for the root of the trunk *n*, formed by the blood-veſſels, as they proceed to the trunk; from thence it runs obliquely backwards, and is articulated with the *Os palati* by a broad ſquamous ſuture; from the middle protuberance of the *Sinus* for the eye *d*, it runs ſtrait backwards for the ſpace of 18 inches, being articulated with that part of the *Os frontis*, which forms the aforeſaid lower edge of the *Sinus*, for the optic nerve *f*; and then it begins to be overlaid with a *Lamina* of the bone, which forms the upper and back-part; from whence it deſcends nine inches, till it comes to the root of the teeth *n*; the above-mentioned protuberance, having formed a part of the *Sinus* for the globe of the eye, as was ſaid, runs backwards ſix inches, and is articulated (by a flat ſuture *g*, which firſt deſcends half an inch, then runs obliquely backwards two inches and a half) with the *Os zygomaticum*; at its beginning it is two inches and a half broad, plain on its inner, and convex on its outer ſurface; bent as it deſcends like a horn, and terminating in a point; from the lower part of this ſuture it becomes much thicker, and having formed a *Sinus* about four inches long, it runs towards the fore-part of the ſcull; from this *Sinus*, as it has returned three inches,

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is formed the side of an oval hole, which running from the fore to the hinder-part, is about three inches and a half long, and two inches from the one side to the other; it was two inches thick at that side, formed by the *Os maxillæ*, and towards the *Processus zygomaticus*; and at its other side, it ran strait backwards from the *Os maxillæ*, in a direct line, with the large cavity, which contains the muscles, that move the lower jaw and *Proboscis*; this hole is analogous to that in a human skeleton in the *Os maxillæ*, beneath the orbit of the eye; and is larger in quadrupeds, being destined for the transmission of a vein, artery, and the superior branch of the second division of the fifth pair of nerves, which in these go to the upper lip and jaw; but in this subject, it is probable they serve for the nourishment and other functions of the *Proboscis*; it is represented by *r r*, Fig. 2, by *m m* Fig. 3. and by 8, 8 Fig. 4. From this hole the *Os maxillæ* inclines six inches towards the root of the teeth *n*: The *Os zygomaticum s*, *h*, *i*, Fig. 2. 3. serves as in all other animals, for a defence to the muscles that move the lower-jaw; in men, and in several other animals, it is formed of a production of the *Os temporale*, articulated with another production from the *Os malæ*, by a particular suture, called *Sutura transversa*; but here it was the most remarkable bone of all the head; for being 12 inches long, and two inches broad, it is articulated with the *Os maxillæ* before, and running backwards six inches, it meets at its superior part, with a production of the *Os calvariæ f*, Fig. 3. as it may be called, which accompanies its lower part other six inches, and then terminates in an obtuse angle; it is loosely join'd with this production, and it is probable, that it is capable of a considerable motion, on the following accounts; 1. The *Sinus*'s in the back-part of the scull, for receiving the condyles of the lower jaw, are larger than the condyles themselves, by which means, they have a pretty good space to move from the right to the left; and the *Os zygomaticum* being their defence on each side externally, which way soever they move, these may be supposed to yield. 2. The lower-jaw is of such weight, that its muscles necessarily require a large space to act in, and that may be conciliated thereto, by the motion and yielding of this bone. 3. The grinders of the lower-jaw are much longer, than those of the upper, and therefore require a larger space to move in, for the better performance of mastication (because the upper-jaw in this, as in most other animals, is immoveable) to which the motion of this bone must very much contribute; add to these, the manner of its articulation; for it rests upon the production of the *Os maxillæ* before

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before, and moves to and fro, as it were behind, upon the production of the *Os calvariæ*, that rests upon it: At the upper part of the back of the scull, the two eminencies, formerly mentioned, appear more considerable, because of the interveening *Sinus*; which from two inches deep, and 10 inches from right to left, becomes four inches deep; for the eminences *a a*, Fig. 4. approach, as they run backwards, much nearer to each other, and the *Sinus* running obliquely downwards, becomes still deeper, having a spine *c*, Pl. VIII. Fi. 1. six inches long, and an inch deep; this spine serves for the insertion of the muscles, that move the head; the bone on each side thereof is very full of *Rugæ*, which seems to be an excellent contrivance; because of the great strength requisite here in the tendons, for supporting the weight of the head of this huge animal; for which end it was necessary that the surface of the bone, whence they arise, should be very unequal, that their fibres might be the more firmly inserted therein; here likewise the tax-wax, above-mentioned was inserted; by means of this spine in the middle and the eminencies on both sides of the *Sinus*, the surface of the bone is much more enlarged, and the muscles with their tendons, are more capable of moving the head, directly or obliquely to either side, than if the bone had been plain; as the spine of the *Sinus* ends, the bone swells out three inches towards the back-part, and then descends an inch and a $\frac{1}{4}$, till it reaches the hole for the spinal marrow *d d*, Pl. VII. Fig. 4. and here the bone from the upper part of the orifice of the *Meatus auditorius f*, on each side becomes protuberant for 10 inches *e e*, till it reaches the *Processus condyloides c c*; this protuberance performs the same office as the *Apophysis Mastoides* in other animals; serving for the insertion of the muscles that bend the head inwards; the *Processus condyloides c c* are seven inches distant inclusive; each of the *Condyles* being two inches and $\frac{1}{4}$ broad from right to left, as they arise gradually from their external side; and from the lower to the upper part, arising semicircularly, as it were, five inches long; the hole for the spinal marrow *d d*, at the upper part, between the *Condyles*, is three inches broad, two inches and $\frac{1}{4}$ at the middle, and two inches at the lower part, till at last it terminates in a point; it is three inches and $\frac{1}{8}$ long, and its margin, about the middle of the *Condyle*, is two inches thick; the bone becomes more flat below these *Condyles*; insomuch, that tending inwards there is a *Sinus* formed, above which, the *Processus styloides g* arises, being there articulated by *Synchondrosis*; this *Processus styloides* is cartilaginous about an inch *h* at its base; whence arising hard

and ſolid for four inches *k*, flat on its inſide, and convex on its outſide, and an inch broad, it is afterwards divided, and ſends out another bone *i* five inches and ½ long; which bending towards the ſcull, but outwards from that place, whence it proceeded, for the ſpace of two inches, it becomes gradually ſmaller, till it terminates in a point, not unlike the nib of a writing pen; between the *Sinus*, below the *Proceſſus ſtyloides* and the *Condyles*, at an inch and a half diſtance, is ſituated the hole for the jugular vein *m m*, thro' which likewiſe the *par vagum n*, Pl. VIII. Fig. 19. paſſes; which being oval, is an inch and a quarter long, and half an inch broad; on the outſide of the *Proceſſus ſtyloides* is to be ſeen the hole *l* for the *Portio dura* of the auditory nerve; this is ſo near the root of the *Sinus*, that it could not be well repreſented in the figure; between the origin of the *Proceſſus ſtyloides g g*, and the hole for the jugular vein *m m*, is lodged the bony part of the aqueduct *n n*; which deſcends five inches; it is ½ an inch broad, and ſo flat, that it could ſcarcely be repreſented in the figure; from thence is a *Crena*, whoſe orifice is repreſented by *o o*, where its fleſhy part was contained, which communicated with the palate; it deſcends three inches obliquely inwards; from the aforeſaid hole *m m* for the jugular vein, is ſituated the hole *p p* for the carotid artery, which is ſo large as to admit the point of one's little finger; deſcending in a ſtreight line from the *Proceſſus ſtyloides g* for three inches and ¼, you come to the hole, where the artery of the *Dura mater* enters the ſcull, and by which the third branch of the fifth pair of nerves paſſes out; here likewiſe the vein, which returns by the large hole in the *Os maxillare* from the *Proboſcis* (after it has paſſed ſome little way beneath the *Lamina*, which forms the upper edge of the *Sinus* for the orbit of the eye) paſſes out, and runs back to be joined with the jugular vein; theſe holes are ſituated on each ſide, between the aqueduct, and the *Sinus*, for the reception of the lower jaw *y*, and are both received within a like *Sinus*, ſo that they could not be repreſented by an orifice; the bone for the reception of the *Proceſſus ſtyloides*, as has been ſaid, is depreſſed; and from thence, for the ſpace of two inches, till you come to the hole *p p* for the carotid artery, it is raiſed for the aqueduct *n n*; from thence, between the two holes, it is gradually protuberant to the *Condyle*; from below this hole *p p*, ſtraight downwards, during the progreſs of the two aqueducts *n n*, which are three inches diſtant, it is depreſſed, till you come to the *Choana*, or paſſage between the palate *t* Pl. VII. Fig. 2. and the root of the trunk *s*; between the two holes *q q* for the artery of the *Dura mater* are

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six inches; the length of the *Sinus*, in human subjects called the glenoid cavity, measuring from that part of it, which is towards the hole for the artery of the *Dura mater q q*, till you come to the extremity of the *Os zygomaticum*, is five inches and ½; this *Sinus* is scarcely at all depressed, it is rather protuberant, with a semicircular surface from the upper to the lower part; it is well enough guarded on both sides; so that notwithstanding this protuberant reception for the *Condyles*, yet their dislocation is prevented on the outside by the extremity of the *Os zygomaticum x*, and on the inside, first by a hollow, and then by a protuberance in the bone; and this contrivance seems very much to facilitate the motion of the jaw; for had this *Sinus* been so proportionably deep, however superficial it might have been, as in human subjects, its motion had not been so free, as we observe it is; for by this semicircular superficies, the *Condyles* have the more room to move backwards, and the lower jaw to be depressed, that it may move forwards, and press the aliment against the upper teeth, with the greater force; the muscles likewise prevent its falling too much back, and the *Os zygomaticum*, its inclining too much to either side; above the large process of the *Os maxillæ*, which is articulated with the *Os zygomaticum*, lies the orifice of the *Meatus auditorius k* Fig. 3; which being oval, is an inch long, and half an inch broad; between this external orifice, and the *Processus petrosus* the *Meatus* is eight inches long; by means of this larger *Sinus* on each side, the basis of the scull is contracted in such a manner, that from the hole *q* Fig. 4. down towards the root of the teeth 3, 4, which is nine inches, the breadth is but seven inches and ½; from the extremity of the bony part of the aqueduct downwards, the base of the scull is composed of two cavernous bones, about two inches and a half thick, with a large *Sinus* in the middle S three inches and half in diameter; at the end of the *Sinus* for the fleshy part of the aqueduct, and at the root of the teeth four inches and a half; this *Sinus*, after it is become two inches deep, terminates in the *Choana*; this passage is eight inches long, and two inches and a half broad, with the *Vomer u* in the middle, extending from thence to the root of the trunk eight inches; the back-part of this *Vomer* is sharp, and thin, but its fore-part is thicker, consisting of two *Laminæ*; Dr. *Moulins*, upon observing the tongue, is of opinion, that the elephant breathes by this passage only, and not by the mouth; but Mr. *Blair* did not find, that this passage was proportionably more patent in this animal, than in any other, only it seemed to be more direct; for as in other

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animals this hole communicates with the root of the nose, and the bone gives the air, at its exit, another direction, so here the fore and back-part of the *Choana* are directly opposite; but then the trunk itself gives the air a quite different direction, than in the bones of other animals; indeed, there is one argument that seems to strengthen Dr. *Moulins*'s opinion; *viz.* That by the trunk the elephant sucks up any liquor it has occasion for, which it afterwards empties into the mouth; and so by drawing in the air, it can keep firm in its extremity, any thing it takes hold of; however the objections formerly advanced against this opinion, seem to be of greater weight, than the arguments here proposed, are for it; these two cavernous bones on each side the *Choana* are filled up from the two firm, solid, white, weighty teeth 3, 4; the posterior of which does not grind, but serves for a wedge, as it were, to keep that before it, 5, firm in its place; this tooth runs obliquely backwards three inches from the fore-tooth; that part of it, which is without the jaw-bone, is half-round, being six inches in surface, from its root on the one side to that on the other, and polished, and smooth like glass; how far this tooth or the other might go up he could not tell, nor give any account of its shape within the bone, unless he had broken the scull; only he observes that the *Alveoli* of the teeth, especially, that which contained the hinder teeth were very thin; the length of each of the teeth is seven inches; these teeth are not alike on both sides; for that on the right side is but an inch without the *Alveolus*, throughout its whole extent on the outer side, and on its inner side, it is protuberant an inch at its fore-part, and two inches at its back-part; whereas, that on the left side is protuberant only an inch before, on the outside, and three inches behind, where it forms a kind of angle, as it is joined with the hinder tooth; and on the outside it is protuberant half an inch before, and two inches behind; the tooth, 2, on the right side grinds with that of the lower jaw, throughout its whole extent; whereas, that of the left, 5, after it has run back six inches, runs up with a half round surface two inches, before it is joined with the hinder tooth; Dr. *Moulins* in like manner takes notice of this difference between the shape, situation, and dimensions of the right tooth from the left in that elephant that died at *Dublin*; for he says, the length of the teeth of the right upper jaw is four inches, but that of the opposite only three; and the two outward, or fore-teeth of the upper jaw were somewhat longer than those of the lower; the Dr. takes no notice, whether the hinder teeth of the upper jaw grind, or not; but in Mr. *Blair*'s subject, not only both the hinder teeth do

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do not grind, but likewiſe ſome of the fore-teeth of the left ſide; theſe teeth, as the Dr. well obſerves, are all *Molares*, being two inches broad, and that part wherewith they grind, ſix inches and a half on the right ſide, and five and a half on the left; their ſurface, tho' flat, is very unequal; for they have alternately placed (running from right to left) a cavity, and then an eminence, and this latter is ſurrounded by a rough protuberant border; there are nine cavities, and as many undulated eminencies; which ſeems to agree with what Mr. *Ray* obſerves; *viz.* That theſe teeth have eight or nine parallell undulated lines in their ſurface; the ſituation of theſe teeth ſeems to Mr. *Blair* to be peculiar to this animal; for inſtead of running from the upper to the lower part, as in other quadrupeds, they run from the fore to the hinder part, as in human ſubjects, being placed at .... inches diſtance, at the beginning, or fore part, and .... inches, at their hinder part; from the fore-part of theſe teeth the *Os palati* runs down .... inches, having the diviſion 10, mentioned above, in the middle much enlarged; as to the thickneſs of this bone, it correſponds to the tuſks, which are implanted in each ſide thereof; it ſeems to be placed in this manner, on two accounts. 1. That it may anſwer to the diſtance, or cover that part of the lower jaw, which runs between the fore-part of the grinders above, *cc*, Pl. VIII. Fig. 2, and the proceſs at its lower, middle part, *e*. 2. That it may give room, as has been above obſerved, for the trunk to reſt upon, leſt it ſhould diſcommode the mouth.

The lower jaw conſiſts of one large bone, with fore and hinder part, and five proceſſes; *viz.* two *Condyles a a* Fig. 2, 3, two proceſſes of the *Corona b b*, and one proceſs of the chin *e*; it is articulated by a double *Arthrodia* with the upper jaw, as in all other animals; the two *Condyles a a*, are 12 inches diſtant incluſive; their ſurfaces are convex, both from right to left, which is three inches and a half, and from the fore to the hinder part, which is two inches; they are received into the *Sinus* of the upper jaw *x*, Fig. 64, which as has been ſaid, is five inches and a half, ſo that they have room enough to move in maſtication; the ſmalleſt part of the neck, below the *Condyle*, is three inches from the fore to the hinder part; from whence deſcending three inches, it becomes ſix inches broad, *b* Fig. 3. and two inches thick at its back part, where it forms an obtuſe angle, from whence running forwards at its outer ſide two inches, it begins to form a *Sinus* for the inſertion of the muſcles, that move the jaw; this *Sinus*, running forwards four inches more, termi-

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nates in a sharp edge of the bone, which descends to form the process of the *Corona b b*; this *Sinus* is eight inches from the upper to the lower part; at the upper part of the *Processus coronæ* it is eight inches broad from the fore-part, where it is sharp, to the hinder part, where it is thick and obtuse, and at its middle nine inches and half, *b b* Fig. 4. the *Processus Coronæ* from the upper to the lower part is six inches, with a semicircular edge, as it were, but somewhat more protuberant, where it is not so sharp as the upper margin; in the inner side of the same part of the bone, we find, descending seven inches from the condyle, till we come a little below the aforesaid obtuse angle, the beginning of a large hole *b b*, Fig. 3. three inches and a half long; *viz.* From the first forming of its *Sinus* to its lower part, and an inch and a half broad; this hole is for receiving the vessels that form and nourish the teeth; here the jaw begins to be about four inches thick behind, being convex in its back-part; from whence running four inches forwards, it inclines about two inches and a half inwards, where it forms a large *Sinus* for the insertion of the *Masseter* muscle, which could not be represented in the figure, because the outside always obstructed the view of the inside; this *Sinus* descends obliquely nine inches from the neck of the condyle, till it comes to the root of the teeth, *c*; which space does not appear so large in the figure, because of the position of the jaw; and from the fore-part of the *Coronæ* backwards, till the jaw become thick, five inches and $\frac{1}{2}$; from the back-part of the jaw, at the aforesaid obtuse angle, till you come to the point of the *Processus Menti b*, in a strait line, is 27 inches; the arch of the posterior surface from the same angle, till you come in a line with the beginning of the teeth, or lower part of the *Corona c*, is 14 inches and a half; from whence measuring outwards from the root of the teeth, it is three inches to the aforesaid lower-part of the *Corona*, from thence to the middle of the back part is five inches; and from the root of the teeth at the external part to the same place at the internal part, is 16 inches, and here the jaw is about four inches thick behind; at the joining of the two teeth strait downwards, it is six inches and a half, and here it inclines gradually outwards for above three inches; whereas its inner surface is almost plain, or at least so for the space of four inches; and then below, it inclines three inches gradually outwards, forming an arch in its progress; the jaw *c*, is at the thickest, strait downwards from the lowest part of the *Corona*; and here it begins to run obliquely forwards, till meeting with the same part of the bone from the other side, it

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terminates in the *Proceſſus menti*, *e*, Fig. 4 *b*, Fig. 2. which runs obliquely outwards, and ſeems very proper for defending the mouth from the inconveniencies of the trunk, which would preſs too much upon it, by its weight, were it not defended, both by that part of the *Os palati*, which runs down from the teeth in the upper-jaw, upon which it reſts; and by this *Symphyſis*, or *Proceſſus menti*, *b*, *e*, which keeps it ſtill inclining downwards, and ſuffers it not to bend inwards: Add to this, that this proceſs may ſomewhat aſſiſt the *Proboſcis*, in its elevation, when the animal bending the head a little forwards may make the point puſh, or beat up the *Proboſcis* from above it; as the lower-part of the jaw in its progreſs forwards runs obliquely downwards, ſo the upper part at the root of the teeth runs ſtrait forwards, or rather inclines a little upwards, *e e*, Fig. 2, 3; ſo that whereas it is only ſix inches and a half from the upper to the lower part, at the joining of the teeth, now it is ſeven inches and ½ ſtrait downwards, and here its ſurface is more plain; for before it was convex and ſemicircular, as it were; but all along the edge of the *Sinus* for the lodging the tongue *d e*, to the outermoſt point of the *Proceſſus Menti*, it is nine inches: Now we conſider the inner part from the place where we left it, and find it ſtill more plain; where meaſuring from below the aforeſaid joining of the two teeth ſtrait forwards, it is four inches on each ſide, till both meet in a ſemicircle *f* Fig. 3. about three inches diameter at the lower-part, and ſomewhat nearer at the root of the teeth; after it has run two inches upwards, it runs ſtrait forwards with a convex ſurface, four inches thick; from thence it aſcends four inches more to the root of the teeth *d*, Fig. 4, this *Sinus* is for lifting up the tongue, which is very narrow and pointed: The condyles are 12 inches diſtant incluſive; whence the bone running downwards, and ſomewhat backwards three inches forms an obtuſe angle, which is 17 inches excluſive diſtant from its oppoſite; and here the bone begins to ſwell by degrees to a conſiderable thickneſs; from thence deſcending gradually eight inches, it is 18 inches diſtant; and thence inclining obliquely forwards eight inches more, it is 14½ inches diſtant; inclining ſtill more forwards to the baſe, where the two bones meet, the bone becoming ſtill thinner, it is nine inches; from which on each ſide, till you come to the *Proceſſus Menti*, it is ſeven inches; this far as to its back-part; now as to its fore-part, firſt there is the condyle *a a*, Fig. 4. then there is a ſharp ſpine, which runs obliquely to the *Coronæ b b*; from whence to the root of the teeth it is thicker, and of a ſemicircular form; oppoſite to this the bone begins to ſwell at its outer ſide,

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and becomes plain at its inner ſide; that is to ſay, that which regards the mouth, and that which does not; its ſurface on both ſides is very ſmooth, with a great many holes for the ingreſs and egreſs of the blood-veſſels, which nouriſh the bone; and at its fore-part, it has two large holes for the *Maxillaris inferior* Z A, Plate VII. Fig. 1. or branch of the fifth pair of nerves, which are diſperſed at the roots of the teeth.

There is immediately below the *Coronæ*, or near thereto, both in human and animal ſubjects, a pretty large hole in proportion to the bulk of the animal, for the emiſſion of a branch of the external carotid artery, jugular vein, and fifth pair of nerves, called *Maxillaris inferior*; which are diſperſed in the roots of the teeth for their nouriſhment, and for giving them that exquiſite ſenſation of pain, which thoſe affected with the tooth-ach are very ſenſible of; and in this hole, in ſheep, calves, and other quadrupeds, eſpecially ſuch as are young, as alſo in children before the ſeventh year, and even afterwards for ſome time, in the cavernous part of the bone, where the teeth do not penetrate the jaw, there are rudiments of teeth to be ſeen; cavernous in that extremity, which is towards the baſe (wherein the ligaments, that keep the root fixed, are firmly impacted) and ſolid at the other extremity; ſo from the above-mentioned large hole in this animal, Mr. *Blair* obſerved ſeveral of theſe rudiments of teeth, lying in layers, or rather placed perpendicularly acroſs the bone of each other's ſide, from the hole *b b* Pl. VIII. Fig. 3, till the teeth began to appear; thoſe that were placed neareſt the hole were ſmaller, not exceeding an inch in breadth, and half an inch in length, *i. e.* from above downwards, cavernous at the lower or back part (for the reception of the ligament, which is guarded by two thin hard *Laminæ*) and ſolid at the other; thoſe neareſt the hole were interſected two or three times by membranes, whereby they could be disjoined; but after he had extracted ſeveral, he found no more any ſuch ſeparation, but that they were entirely cavernous from the right to the left; each of them was inveſted by a membranous tunicle, a *Perioſteum*, as it were, and had ſomething reſembling a cartilaginous ſubſtance between them; their ſurface is very unequal at the orifice, where they receive the ligaments, and veſſels *c*, as if they had been folded up into ſeveral *Plicæ*, and afterwards taken aſunder; and from it there run ſeveral ridges and furrows *b*, from one extremity to the other; where the ligaments ceaſe, they become exceeding ſolid, and ponderous, and at their upper extremities, ſemicircular, and ſometimes they are formed into digitations *a* Pl. IX. Fig. 1, when they

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approach to that part of the bone, where the teeth appear, they begin to quit the *Periosteum*, by which they were distinguished, and unite close together, so as to form one bone; it is observable, that at their upper extremity, there is a *Lamina*, which being convex towards the jaw, and concave towards these rudiments of teeth, knits, as it were, their solid extremities together, from which it is also separated by an intermediate membrane at first; but afterwards that disappearing, this *Lamina* conjoins them at the extremities, in the same manner as at the sides, before they appear without the jaw; and thus Mr. *Blair* supposes, these teeth to be formed; and it is by these, he is persuaded, the jaw becomes so ponderous, and thick; and what confirms this opinion is, that the hinder teeth of both jaws (for he does not doubt, but that these rudiments of teeth are likewise in the upper jaw) before they come to grind, have their upper parts semicircular; and that both before, and after the formation of the grinders, the lines of these rudiments appear plainly like so many ridges *d e*, Pl. VIII. Fig. 4, with intermediate furrows, where they had formerly been distinguished by membranes; and he supposes, tho' they are united at the upper extremity into one compact bone, yet that at their lower extremity they have still the same cavities for the reception of the ligaments, and vessels, as formerly; and this opinion is confirmed by *Tentzelius*'s account; the lower as well as the upper jaw, has four teeth, two on each side; *d e*, Fig. 2, 3, all *Molares*, but no *Incisores*, or fore-teeth; the hinder teeth are eight inches, and the fore-teeth not four inches distant, between which is placed the *Sinus d e* for the tongue; and it is observable, that from thence to the bottom, the *Sinus* is contracted in such a manner, as to be only an inch broad *f*; the hinder tooth on the right side is four inches, and on the left five inches; half their surface, where they begin to appear, is semicircular, with the above-mentioned ridges and furrows, running transversely, four on the right side and five on the left; the other half has five of those eminencies (of which above, when speaking of the upper jaw) where it grinds, and four on the left; each of the fore-teeth is six inches long, with six or seven of the above-mentioned eminencies, and as many depressions; the hinder teeth of Dr. *Moulins*'s elephant seem to have been of an equal length on both sides, and much longer than the fore-teeth; it is observable, that the ridges at the sides correspond to the eminencies, where they grind, and the furrows to the depressions; the teeth of the lower jaw exceed those of the upper, about two inches in length, by which it appears, that the motion of the lower jaw

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muſt be very conſiderable in maſtication, and that the elephant moves the jaw, moſtly from the hinder to the fore parts, and ſcarcely from one ſide to the other, as in animals, that ruminate or chew the cud; theſe teeth are the firmeſt, moſt ſolid, and weighty bones of any animal, yet known, and are as good ivory, as the tuſks themſelves: Mr. *Blair* queries, whether theſe rudiments of teeth may not be ſuppoſed, in proceſs of time to deſcend, and expel thoſe already formed, and ſucceed in their room; and if not, what may be their uſe? As to the firſt query, it is true, that children have two ranges of teeth, tho' not equally ſolid; the ſecond range expells the firſt, at, or about ſeven years of age, and ſucceeds them; the firſt being only ſo many ſheaths, or covers, whereby the ſecond, being yet but a ſoft mucilaginous ſubſtance, are defended from external injuries, till in proceſs of time they have attained to a ſufficient hardneſs; and there is a great difference in the teeth of ſome quadrupeds; ſuch as young horſes, whoſe foal, or colt-teeth, as they are called, have ſome marks, which are obliterated after a certain period of years; ſo that it would ſeem, if theſe teeth are not expelled, yet that their ſurface is gradually worn off, and inſtead of that, their roots increaſed, and the teeth themſelves undergo ſuch an alteration, as that their age is no longer known by theſe marks; Mr. *Blair* has already obſerved, that there are ſeveral ridges and furrows in the teeth of this animal, which ſeem to prove, that theſe rudiments have coaleſced and become one tooth; but whether the rudiments, which have not yet appeared without the jaw, do even expel thoſe, which have appeared and ſucceed them, is the queſtion; no experiment having been yet made concerning their production in this animal; the period of time that elephants live, and the age of this Mr. *Blair* treats of, being unknown, no poſitive determination can be given in this matter; yet he is apt to believe, that theſe teeth, as well as the rudiments, have been from their firſt formation, and that becauſe. 1. The jaw-bone adheres ſo firmly to the teeth on both ſides, as ſoon as they appear; and the place of their roots is ſo well known (by the protuberance on the outſide of the jaw) to be enlarged within the *Alveoli*, that he does not ſee, how they can be expelled by a ſucceeding ſet. 2. When one ſet of teeth expels the other, the ſecond is uſually below the firſt, and not placed in the ſame line, as theſe here are; and this leads him to enquire, what may be the uſe of theſe rudiments; and this he ſuppoſes to be 1. In order to fill up the cavity of the lower jaw. 2. By their weight to add ſtrength in maſtication. 3. That there may be ſo many different bones to aſſiſt

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assist the teeth in their motion, and, 4. To serve instead of a wedge, for keeping the teeth firm in their sockets: For the first, it was convenient, that the lower jaw should bear an equal proportion in its bigness to the upper, and have sufficient room for the insertion of the muscles fit for its motion; and if of a proportionable bigness, then the bone must be either altogether solid, or cavernous, and filled up with some other ponderous substance; for, if spongy or cellulous, then it would have been too light, which would have been very inconvenient; as to the second, the weight is of considerable moment, for the more exact attrition of the aliment, which is here requisite, because the tongue of this animal is both small and smooth on its surface, without those sharp cartilaginous *Papillæ*, those animals are endued with, whose teeth are not sufficient to grind their food; as to the third, he imagines that these rudiments, with their intermediate membranes, may be the more helpful to the teeth in their motion, (if they have any) or in their pressure, than if the surrounding jaw had been one entire continued solid bone; as to the fourth, a hard and soft substance, placed alternately, is certainly more convenient for keeping any thing firm, than either of the two alone; for, had they been hard substances, that lay upon each other, then neither would yield to the pressure; and if soft, tho' they yielded, yet they would not retain so well the pressure they receive, nor keep any thing so firm, as if they had some intermediate substance; in a word, be the use of these rudiments what it will, the teeth, and they together, have rendered this so ponderous, as to amount to 45 pounds weight.

A Continuation of the Osteology of an Elephant, by the same.
Phil. Trans. N° 327. p. 117.

AS there is no animal, in proportion, that has a greater quantity of brains than man, so there is none that seems to have less than the elephant; in the one, it was so ordered by the wise governour of all things, that they might be sufficient for the generation of such a quantity of spirits, as are requisite for the performance of the rational and animal functions; and in the other, had the quantity of brains been greater, the *Principia Nervorum* had been more divided; so that, instead of being requisite, they had been vastly inconvenient; because the nerves could not so well receive the spirits dispersed in a larger mass, as now when contracted

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within narrower bounds; and such a contrivance as this being requisite, the interposing such a vast distance between the two tables of the skull, as shall be shewn hereafter, is a stupendous piece of mechanism: There are, as was observed above, several *Laminæ*, *h h*, Pl. VII. Fig. 2. to be seen in the bottom of the hole for the root of the trunk; these *Laminæ*, taking their origin from hence, run backwards in a parallel, and sometimes an oblique line, to the second table of the scull, or that part of it which invests the brain; and these *Laminæ*, being placed either horizontally, perpendicularly, or obliquely, meet with and intersect each other, forming intermediate cavities or cellules, *d d*, Fig. 65. of different magnitudes, positions, and figures, according to the intermediate walls or sides of which they are composed; so that, tho' Dr. *Moulins*, and after him *Tentzelius*, seem to assert, that they were mostly triangular; yet Mr. *Blair* observed them quadrangular, pentagonal, hexagonal, and rectangular, and even sometimes irregular; these cells run from the outer table, or external parts of the skull, *a a* to the inner table, or seat of the brain, *b b*, and communicate with each other by pretty large holes, towards either the inner or outer table; and sometimes two, meeting together in the middle, form a third; in a word, as there is no certain rule observed in their figure, so neither is there any in their communication; the space they fill up, between the two tables before, is 11 inches, at the sides eight inches, towards the back part but three inches, and at the hole *a*, Fig. 6. for the spinal marrow, both tables meet together; for the brain is placed in the lower and back part of the scull; all these cellules were empty, and only covered over with a thin membrane; Dr. *Moulins* observes, that there are several blood-vessels, beautifully disseminated throughout the surface of these cellules, with different divarications; and *Tentzelius* says, he observed several lineaments of vessels, after the same manner; this was not at all to be observed in Mr. *Blair*'s subject, nor was there so much as the vestige of a vessel to be seen, the reason of which he supposes to be this; *viz.* that since the one was burnt, and the other overwhelmed with earth, both suffering violent deaths, they must have had vast strugglings, as Dr. *Moulins* and *Tentzelius* both affirm; by which violent motions, the blood must have been propelled with a vast force from the larger trunks to the smaller capillaries, where it distended the vessels, and rendered them perceptible to the sight, after the death of the animals;

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animals; whereas this subject, having laboured under a languishing distemper for some time, as appears by the *Polypus*'s found in the heart, and other vessels, the motion of the blood must have been very languid, and scarce able to convey itself to these capillaries, so that the sides of the vessels being collapsed, they became imperceptible; but what is more remarkable, is, that not so much as any of the furrows, which these vessels might have made in the *Laminæ*, appeared at all; and yet the furrows were still very evident in the bones found in *Germany*, with the blood-vessels, containing the dried blood, closely glu'd to them, and turn'd of a yellowish colour, and that, perhaps, after some thousands of years, as *Tentzelius* observes; it is true, that upon viewing the cellules more narrowly, Mr. *Blair* found all their *Laminæ* full of small holes of an indefinite number, and irregularly placed, through which these vessels seem to have passed from one cellule to another: so that, tho' not so observable, yet no doubt they were dispersed thro' them in this, as well as in other elephants.

As to the use of these cellules, there have been several opinions advanced about them; as, 1. That since the elephant has been observed to suck up a great deal of water by the *Proboscis*, possibly that water is received into these cellules, because of the communication they seem to have with the *Proboscis*; and that thereby they cool their brains in hot countries, where they abound. 2. That since the elephant has a very acute sense of smelling, they think that the olfactory nerve is disseminated (after it has passed the *Os Ethmoides*) throughout the fine membranes that cover the *Laminæ*, which form those cellules. 3. That these cellules, being interposed between the two tables of the scull, only serve to render the head less weighty: As to the first, admitting that the water could be received into these cellules, which, from their position at the root of the trunk, it is plain it cannot, there being no muscular substance to expel these waters, we cannot suppose this to be their use. As to the second opinion, the olfactory nerve, after it has passed the *Ethmoides*, does not at all communicate with these *Laminæ*, but penetrates the *Os Vomeris*, from whence the cartilaginous *Septum* of the *Proboscis* arises; so that, these cellules can be no ways assisting to that end, the sensation of smelling being chiefly performed in the *Proboscis*, and not by the fibres of the olfactory nerve disseminated in these *Laminæ*; which here

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are quite otherways disposed than in men, dogs, &c. whose *Laminæ Spongiosæ* are situated in the root of the nose, so that the air must affect them, before it reach the *Os cribrosum*; whereas, here the *Laminæ* are situated in such a manner, that the air affects the olfactory nerve as soon as it can affect them: The third opinion seems more probable to Mr. *Blair*, as also to Dr. *Moulins*, and that upon several accounts; as the consideration of the small extent of the seat of the brain, to which did the rest of the head correspond, it would have had no proportion to the body; nor could the muscles, fit for moving the head, have sufficient room for their insertion, nor the *Proboscis* for its origin; so that there was a necessity for interposing some distance between the inner and outer table of the scull; now, this distance must be filled up with some intermediate substance, and had that been either carnous, or osseous, whether spongy or solid, or (as some suppose the *Sinus frontales*, *maxillares*, and *basilares* in human sculls to be) mucous; should either of these have filled up such vast bounds, the head would have been rendered too weighty; therefore it is wisely ordered by Providence, that there should be only thin *Laminæ* of bones disposed in such a manner, that the outer table of the scull may be the more strengthened for supporting the weight of the muscles of the head, lower-jaw, and *Proboscis* adhering thereto; that it may have a communication with the inner table, and that the space between these *Laminæ* may be empty, lest by any intermediate substance, the head had been too heavy, as is said, and the inner table so burdened, as to press too much upon the brain, which might have disturbed the animal œconomy; a structure analogous to this, we find in oxen, which have the same cellules between the two tables of the scull; especially towards the horns, whose stints, as they are called in *Scotland*, or the bony substance, whereby that part of the horn, which is towards the head, is fill'd, are likewise cellulous; lest by their weight, together with that of the horns, they should prove uneasy to the head: But lest by these vacuities, which are all placed in the upper, and fore-part of the head of the elephant (for the brain, and *Elevatores capitis* are sufficient to depress its back parts) it should be rendered so light, as not to be equally poised, or kept steady; the teeth both in the upper and lower-jaw, are render'd thus weighty, to be a counter-balance thereto.

The inner surface of the scull, in shape resembles a human one, but more spherical, being from right to left 10 inches, from the fore to the hinder part nine inches, and from the upper to the lower

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lower part at the anterior *Fossa* seven inches; between the middle, five inches, and at the posterior part, or seat of the *Cerebellum* four inches and a half; it has four *Fossæ*, and five eminencies; the anterior *Fossæ bb*, Pl. VIII. Fig. 19. is circumscribed by the fore-part of the inner table of the scull, before, and by the two anterior eminences *c c* behind; here the brain sends forth its largest production; for at the hinder part, this anterior *Fossa* is depressed strait downwards near two inches, where the *Os Ethmoides* begins, which is of a singular shape and structure; for from the fore-part of the seat of the brain in the middle, there is here, as in most sculls, an eminence that runs obliquely downwards, 'till it begins to form the *Crista Galli d*, so call'd in human subjects; this *Crista Galli*, divides the *Os Ethmoides* into its right and left part; it is pretty thick and broad at the base, from whence it arises on each side, till it begins to form a *Crena*, which is perforated by three pair of holes; and then there arises a small *Spina d* in the middle; at the anterior extremity whereof, it reaching further than the *Ethmoides*, there is another hole; from this *Crista Galli* run on each side, several prominent convex lines, some obliquely forwards, others obliquely backwards, and others transversly; each of which is branched out twice or thrice towards the circumference, which could not be represented very lively in so small a figure; these lines have some few perforations, running from their highest part, but most of them are between their interstices, where they are beautifully dispersed after a certain kind of order, which likewise could not be shewn in the figure: The *Os Ethmoides* is not unlike a heart, as it is usually represented, being narrower at the hinder-part, where the anterior *Fossa* runs strait down from the fore-part of the *Sella Turcica u*, and broader at the fore-part of the bone, which runs obliquely upwards therefrom; from the fore to the hinder part it is three inches and a half, and from the right to the left four inches; its circumference is not altogether circular; the peculiarity of this structure gives ground to enquire into its reason, and the acute sense of smelling, with which according to all authors, this animal is endued; in most other animals, neither is this anterior production of the brain so great, the perforations of the *Os cribrosum* so many, nor its extent so large; but in animals of an acute sense of smelling, besides the perforations of the *Os cribrosum*, there are several spongy *Laminæ*, which arise from its lower part; each of which is supplied with tunicles, wherein several branches of the olfactory nerve are variously disseminated; and these *Laminæ* are set very near each other, resembling the teeth in a comb, or the *Lamellæ* in the

lower

lower part of ſome muſhrooms; both the contrivance of the *Laminæ*, and their thick diſpoſal, are very uſeful for ſenſation; for whereas had this olfactory nerve ſtill continued in one trunk, the volatile ſaline particles would have only acted upon ſuch filaments as compoſe the ſurface; whereas the nerve being variouſly diſperſed into divers branches, and theſe branches differently diſpoſed into ſeveral ſurfaces, it is capable of receiving impreſſions from as many ſaline particles, as there are different branches, and ſurfaces, into which theſe are diſpoſed; add likewiſe, that the ſharp edges of theſe *Laminæ* being towards the air, they are more capable of dividing the column of air, ſucked in by the noſe, and giving a greater tenſion to the nervous filaments diſſeminated in them, whereby the ſenſation is communicated the more lively to the common *Senſorium*; and it is obſervable, that ſuch animals as have moſt of theſe *Laminæ*, have their ſenſe of ſmelling the more acute: Now, this ſtructure is only to be ſeen in thoſe animals, whoſe *Septum intermedium* and two ſides of the noſe, conſiſt of bone, at leaſt ſo far as their *Laminæ* are extended; but it is otherwiſe with the elephant, whoſe *Os Ethmoides* is very thin, and has no ſpongy *Laminæ* adhering to its outſide, nor a bone for the *Septum*, or ſides, to guard theſe *Laminæ*, which would have been inconvenient; for then the *Proboſcis* could not have moved with the ſame facility, even from its root, as now it does; therefore to ſupply this defect, and ſtill to continue the ſenſe of ſmelling ſo acute, if not more ſo in this, than in many other animals, it is provided, that the anterior *Foſſa* be very deep, that the production of the brain therein might be the greater; and leſt its ſurface ſhould ſtill be too ſmall, there ſhould be eminent lines, both in the *Vomer*, and throughout the reſt of the bone, that there might ſtill be more ſpace for branching out the nerve, as it proceeds from its origin: There may alſo be another reaſon alledged for theſe protuberances, *viz.* becauſe the brain being more pendent here than elſewhere, they may ſerve as ſo many columns to ſupport it; leſt by its weight it ſhould preſs too much on the *Os cribroſum*, ſo that the origin of the olfactory nerve being too much compreſſed, it might yield, inſtead of a diſtinct, a very confuſed ſenſation; and that, even within the ſcull, it may be divided and diſperſed in ſuch a manner, in this animal, as it uſes to be without it in others; ſo that the defect of the ſpongy *Laminæ* without, is ſupplied by this diverſity of perforations and eminencies in the *Os cribroſum* within; indeed there is ſomewhat of this ſtructure to be obſerved in horſes; the *Os cribroſum* ſeems to be proportionably as large, its perforations as many, and the

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ſpongy *Lamina* without, both few and thin ſet; by which that animal has but an ordinary ſenſe of ſmelling, and only ſuch as is proper for the choice of its food; becauſe, the olfactory nerve has not ſuch a ſpace, wherein to be diſſeminated, as the *Septum* and cartilaginous ſides of the *Proboſcis* afford; which ſpace is ſo large that ſcarce a particle of any odoriferous ſubſtance can miſs affecting ſome one or other of the nervous filaments; whereas in horſes, there being but a ſhort ſpace between the *Os cribroſum*, and the noſe, the additional ſurfaces of the ſpongy *Lamina*, and the tenſion of the bone of the noſe on both ſides (otherwiſe than in the elephant, who has no bone there at all) are very convenient to ſupply that defect; for the more extended a nerve is, the greater is its ſenſation, and a bone is fitter for tenſion than either a cartilage, or any other ſoft ſubſtances are: The anterior *Foſſa b b* Fig. 19. is from the right to the left, eight inches, and from the fore-part to the optic nerve behind four inches and a half, and in depth, *i. e.* ſtrait down from the *Sella Turcica*, or in the middle between the aforeſaid holes to the bottom of the *Os Ethmoides* on each ſide two inches and a half; the two middle *Foſſæ* are bounded before by the two anterior eminences *e e*, and behind by the two *Proceſſus petroſi s s*; the ſeat of the brain is here 12 inches in diameter *r r*; in the center between the two anterior proceſſes is the firſt pair of holes *f f*, at an inch diſtance; theſe run obliquely between two ſmall eminences, where the pituitary gland was lodged, called the *Sella Turcica u*; and theſe two proceſſes in human ſubjects are called *Clinoides*; this pair of nerves runs obliquely downwards ſix inches, and paſſes out below the *Lamina s*, Pl. VII. Fi. 3. on each ſide of the head; which forms the upper edge of the *Sinus* for the globe of the eye, being the ſecond pair, called the optic nerves; theſe two proceſſes running ¼ an inch back on each ſide, afford at the ſame diſtance, two holes more, paſſing in below them, which could not be ſhewn in the figure; this is called the *Foramen lacerum*, and thro' it paſs the third pair, or *Oculorum motorii*, the fourth pair, or *Pathetici*, the opthalmic, or firſt branch of the fifth pair, and all the ſixth pair *g g* Pl. VIII. Fig. 19; the third pair of holes is at the back of the two anterior eminences, between the firſt pair, and the external part of the ſeat of the brain, four inches diſtant from each other *h h*; they are the largeſt of all thoſe in the bottom of the ſcull, excepting that for the ſpinal marrow, and have a peculiar uſe, as mentioned above; *viz.* that they ſerve for the tranſmiſſion of the ſuperior branch of the ſecond diviſion of the fifth pair of nerves, and a branch of an artery, which proceeds from the artery of the

Dura mater kk, being separated therefrom by the bony *Septum*, which passes between it and the hole for the third branch of the fifth pair *ii*; and running along the *Crena xx*, passes out with the aforesaid second branch *gg*; the fourth pair of holes is for the egress of the third branch of the fifth pair *ii*, and ingress of a branch from the artery of the *Dura mater*; and the fifth pair is for the artery of the *Dura mater* itself *kk*; the sixth pair is for the carotid artery *ll*, which is otherwise situated here, than in human subjects; for in them it lies between the *Processus petrosus*, and the two posterior *Processus clinoides*, whereas here it lies between the *Processus petrosus* and the center of the base of the scull, on each side, distant about three inches from each other; the seventh pair is for the auditory nerve *mm*, being situated in the *Processus petrosus*, SS; and here it is observable, that from the side of the hole, where the carotid artery *ll* passes towards the *Os petrosum*, there is a hole which runs outwards about an inch and half, and forms an angle; and then passing by the sides of the cavity of the *Tympanum e*, runs strait downwards, and penetrates the scull *l*; this Mr. *Blair* takes to be the hole for the *Portio dura* of the auditory nerve; which does not here, as in other animals, pass in at the hole of the *Processus petrosus* with the *Portio mollis*, but as it proceeds from the brain, goes along the sides of the carotid artery to this hole; this *Portio dura* was much larger as he traced it running forwards above the temporal muscle, and going to the upper-lip to be afterwards dispersed in the *Proboscis*; the eighth pair is for the internal jugular vein, and *par vagum*, which passes out at the same hole *nn*; and the ninth pair is for the spinal marrow, of which already.

The external ear of this huge animal lies flat, and not protuberant, as in other quadrupeds; whose cartilaginous substance is capable of divers motions, performed by several muscles, whereby the inner ear is preserved from the great violence of the external air; which on some occasion, might perhaps, injure, or break the thin, and delicate membrane of the *Tympanum*; it is also for this reason, that the *Meatus* is further guarded, by the contortions, and oblique position of the cartilage at the orifice of the *Meatus*, which only admits of a determinate quantity of air, sufficient for the vibration of the membrane of the *Tympanum*, by which a distinct sound is conveyed to the common *Sensorium*; whereas, did the admitted air exceed its due proportion, nothing but the confused idea of sound would follow; such as resembles the rushing of water, &c. or that noise often observed, when by a cold, or the like obstruction, are caused within the ear itself;

and

and in man, because the external ear is also flat, not only are these windings and *Meatus*'s observable in the cartilage at the entry, but the *Meatus* itself is likewise situated obliquely, to prevent the aforesaid inconveniencies; but there is no need for such a contrivance in the elephant, the external orifice of whose *Meatus* is patent (being scarce guarded by the cartilage) and streight; and its length (it reaching from the external to the internal table of the scull) is sufficient to prevent the accession of too great a quantity of air to the *Tympanum*; for in its progress most of the columns of the air beat against one, or other of the sides of the *Meatus*; insomuch, that their force is impaired, and only so many as are sufficient to convey the sound, can reach the *Tympanum* itself: The *Meatus auditorius* then is a long, streight tube, or canal, situated horizontally, and reaching from the outer to the inner table of the scull, in shape not unlike the barrel of a pistol, but somewhat oval; the sides of its cavities are hard and solid, about the thickness of a half-penny, from whose external part, several of the *Laminæ* Fig. 5. between the two tables of the scull, arise; its cavity is an inch, or $\frac{3}{4}$ of an inch in diameter, and nine inches and a half in length, being somewhat enlarged, as it arrives at the *Crena* for the membrane of the *Tympanum* Fig. 6: This *Crena* is two inches and $\frac{1}{2}$ in circumference, within which is the cavity of the *Tympanum*, consisting of two different superficies, the one much deeper, and cellulous, the other more superficial, and smooth; the first runs perpendicularly down, half an inch from the *Crena* of the *Tympanum*; its bottom is variously divided into several cellules, not unlike a honey-comb, but disposed irregularly; its bony *Laminæ*, by which these cellules are distinguished from each other, are thicker at the top, than at the bottom, being one line, two lines, or one line and a half distant from each other, and about $\frac{1}{4}$ of an inch deep; no doubt, but these cellules communicate with each other, by means of certain orifices, which serve to convey what superfluous moisture is contained in them; for we may reasonably suppose, as in all other cavities of the body, that there are certain glands for separating proper liquors; so here, there seems to be a necessity for secreting a certain quantity of moisture, fit to lubricate the muscles of the ossicles, and facilitate their motion, as also to preserve the membrane of the *Tympanum* from becoming too dry; this driness of the membrane of the *Tympanum*, and the thickness of the liquor secreted by these glands, are often the cause of a deafness in human subjects, especially, such as are advanced in years; this cellulous

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ſtructure of the cavity of the *Tympanum*, ſeems to be very proper for receiving of the ſuperfluous moiſture, and theſe communications are requiſite for conveying it from one cellule to another, till it is emptied into the aqueduct, the common receptacle of which hereafter: This firſt, or cellulous cavity is two inches broad, and reaches from the *Crena* of the *Tympanum* to the *Foramen ovale*, or entry into the *Veſtibulum*, which is ſhut up by the *Stapes*; the ſecond part of this cavity *e* Fig. 6. is more ſuperficial, in ſhape not unlike a pear, from a narrow beginning becoming broader, and more ſuperficial; terminating ſemicircularly; ſmooth in the bottom, with ſeveral incurvated lines, running a-croſs it; it reaches much farther than the *Veſtibulum*, being one inch, and five lines from the fore to the hinder part, and one inch tranſverſely where broadeſt; what ſuperfluous humour it contains is diſcharged into the above-mentioned aqueduct; beſides the ſaid uſes of theſe two cavities, *viz.* to receive and diſcharge the ſuperfluous moiſture, they are likewiſe very beneficial, and aſſiſting to the hearing; for no ſooner is the external air modulated, and the membrane of the *Tympanum* moved thereby, than the ſound is conveyed by the oſſicles to the auditory nerve, and the undulation continued; firſt by the *Anfractus's* of the firſt cavity, and then by the *Gyri*, and incurvated lines of the ſecond; ſo that we may eaſily account for the acute ſenſation of hearing wherewith elephants are ſaid to be endued; for as the tame ones are moſt exact in obeying their maſter's commands, ſo the wild ones are ſoon aware of what traps are laid to catch them, by the tremulous motion conveyed to their ear from the cavernous parts of the earth, where the pit, into which it is expected they ſhould fall, is dug; it is therefore eaſy to explain, whence the acuteneſs of this animal's ſenſation may proceed; for as the olfactory nerve has a large ſpace wherein to be diſſeminated; *viz.* the two cavities of the *Proboſcis*, which are both long and large, ſo that ſcarce any column of air can enter into them, but ſome one or other of the filaments of the olfactory nerve ſpread in theſe cavities muſt be affected; whereby the ſenſation of ſmelling muſt be conveyed to the common *Senſorium* in a more intenſe degree, and the animal ſoon become ſenſible of whatever appproaches it, that is noxious, or nauſeous to it, and thereby be appriſed how to avoid it; ſo this ſtructure, for a quick conveyance, and long continuance of the ſound, is a great means both to make the elephant ſoon receive the ſound, and have a deep impreſſion thereof: The aqueduct is a flat tube, or canal, whoſe orifice is ſituated in ſuch a manner between the two

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cavities above-mentioned, that if there be any ſuperfluous humour contained therein, it muſt needs be diſcharged, at leaſt in this animal, into the mouth; for as it is ſituated, where the firſt cavity terminates, ſo likewiſe the ſecond, from a broader, and much larger beginning, muſt needs diſcharge its moiſture, by its narrower, and deeper termination, into this receptacle; it alſo deſcends directly towards the mouth, paſſing thro' the ſcull, below the hole for the jugular vein *m m*, Pl. VII. Fig. 4, between the hole for the carotid artery *p p*, and that for the artery of the *Dura mater* *q q*; from whence deſcending to *n n*, it is joined with its fleſhy part, which diſcharges itſelf into the mouth on each ſide, behind the back part of the inner teeth of the upper jaw; this ſituation of the aqueduct makes it plainly appear, that its uſe is to receive the ſuperfluous moiſture from the cavity of the *Tympanum*; for beſides the glands above-mentioned, fit for ſecreting ſuch a quantity of moiſture, as may lubricate the muſcles, and facilitate both their motion, and that of the officles; the very vapours that ariſe in ſuch a cavity, as that of the *Tympanum* in this animal, muſt at laſt be converted into a liquor; and that muſt either be received again into the blood-veſſels, or otherwiſe diſcharged by ſuch a receptacle, as this; farther, if there be a neceſſity for glands in the *Meatus auditorius*, without the *Tympanum*, to ſeparate a certain liquor, by which the acrimonious particles of the air are obtruded, and hindered from being offenſive to the nervous membrane of the *Tympanum* (which muſt have an acute ſenſation) and for moiſtening it, whereby it receives the vibration of the air the more eaſily; ſo, ſuch glands as theſe ſeem to be requiſite in the cavity of the *Tympanum* for the uſes above-mentioned; and ſince what is ſuperfluous of this moiſture, cannot be diſcharged outwardly, as that of the *Meatus*, this aqueduct ſeems to be moſt convenient for that purpoſe: Some are of opinion, that this aqueduct is alſo aſſiſting to the hearing, eſpecially in men; becauſe it is generally obſerved, that they who are deaf, open their mouths wide, when they are deſirous to hear more diſtinctly; but it does not appear, how that can be; for tho' the cavity of the bony part of the aqueduct, in moſt animals, is proportionably large enough, yet its carnous part lies for the moſt part ſo flat, and its two ſides are ſo collapſed, that ſcarce any air can be admitted, at leaſt ſo far as to be ſubſervient to hearing: The officles in this, as in other animals, are three, or rather four in number; for tho' the quadrangular bone of *Du Verney* was not found, yet, there is good reaſon to believe it really was there; becauſe there

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is a conſpicuous *Sinus*, in the extremity both of the *Incus*, and *Stapes*, where they are articulated, ſo large as to contain the head of an ordinary pin; and when we conſider the angle, which muſt have been formed by the articulation of theſe two bones, we may ſuppoſe, that this ſmall bone ſerves for the ſame purpoſe, as the *Patella* in the knee, and ſeſamoidal bones in the fingers and toes: The *Malleolus* is an irregular bone, and doubtleſs, it had pretty large muſcles, becauſe of the *Rugæ*, protuberances and *Sinus*'s obſervable therein; it has a protuberant head 1 Pl. VIII. Fig. 8. four lines broad, next to that a *Crena*, or ſemicircular *Sinus* 2; after which the bone is raiſed, affording a protuberant margin to an oblong *Sinus* 3, for receiving the head of the *Incus*, four lines broad; the oppoſite ſide of this *Sinus*, or back part of the bone, is convex, of an irregular rugous ſurface, with a great many eminencies and depreſſions, for the origin and inſertion of the muſcles, for the ſpace of five lines, where it forms an angle; from whence it becomes flat, and ſmooth, being three lines broad, and reaching four lines to another angle 5, where the *Manubrium malleoli* begins, and where it becomes more round; from whence it gradually tapers to the point, being ſix lines in length: The head of the *Incus* 1. Fig. 9. is four lines broad, below which is the neck, or an oblique *Sinus* 2; next to that are two *Apophyſes* 3, 3, one on each ſide; theſe deſcending obliquely outwards, and becoming flat, meet in a point 5, Fig. 11, from whence aſcending obliquely inwards, this production is joined to another ſmall round one 6, like the *Manubrium malleoli*, four lines and a half long; this has the above-mentioned ſmall excavation, or ſemicircular *Sinus* 7, which with the extremity of the *Stapes*, is ſuppoſed to have contained the *Os quadrangulare*, or rather *Orbiculare*, according to the ſhape of the *Sinus*: The *Stapes* differs much in ſhape, from the human *Stapes*; from its concave extremity it is enlarged on each ſide by two ſmall ſlender productions, 2, 2, Fig. 10. not unlike the proceſſes of the *Vertebræ* of ſome fiſh, to which is joined the baſis Fig. 11. almoſt as thin, as the ſcale of a fiſh; this was accidentally ſeparated from its two ſides, and remained in the *Foramen ovale*; it is concave towards the *Stapes*, and convex towards the *Veſtibulum*: The *Foramen ovale* lies ſo hid, and oblique in the ſide of the cavity of the *Tympanum*, that it could not be delineated in its true dimenſions; near it there is another hole, oblong, and ſharp at both ends, both which afford an entry into the *Veſtibulum*; the *Veſtibulum a* Fig. 16. is of an irregular ſhape;

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for the moſt part it is three lines from the one ſide to the other, and perforated by eight orifices, *viz.* five *a* Fig. 15, 16, for the canals of the labyrinth, one *b* Fig. 16. for the *Cochlea*, and two *b*, *c*, for the *Feneſtræ*: The *Cochlea* is a long cavity, conſiſting of three gyrations, or meanders *d e f*, Fig. 18. its orifice, where it proceeds from the *Veſtibulum*, is but ſmall; but it afterwards widens, ſo that the firſt courſe of this cavity is a third part longer than the ſecond *e*, and the third is proportionably leſs than the other two *f*, till it terminates in an orifice *g*, ſituated in the top, for receiving a branch of the *Portio mollis* of the auditory nerve; which accompanies, and paſſes along all its gyrations; the hardneſs, and ſolidity of the bone (for which it may be juſtly called *Os petroſum* in this ſubject) was ſuch, that the three canals, or ducts of the labyrinth could not be exactly traced, ſo as to give a true idea of the manner of their ſeveral meanders; but *Valſalva*'s figures of the human ear direct ſo exactly, that the ſeveral orifices are eaſily found out; and opening them, you diſcover their ſituation, and true dimenſions, by introducing a hog's briſtle; thus after laying open the two *Foramina*, which give an inlet to the *Veſtibulum*, you ſoon perceive the ſeveral orifices, which in ſo large a ſubject, are pretty conſpicuous; firſt turning to the one hand, you diſcover the duct of the *Cochlea*; and this is traced all along the protuberance *d* Fig. 7. in doing of which, you lay quite open the leſſer duct of the labyrinth *d*, Fig. 15, 16; then turning up the other ſide of the bone, you trace the *Portio mollis* of the auditory nerve, divided into two branches; one of which is diſtributed into the *Cochlea*, and the other into the labyrinth; in filing the bone a little farther, you open a ſmall part of the *Ductus medius*, and ſoon diſcover the *Ductus major*.

The labyrinth conſiſts of three ſemilunar lines, or incurvated ducts, whereof the *Ductus major b* Fig. 15. lies in that part of the bony proceſs, which regards the ſeat of the brain; this is 20 lines, or an inch, and three lines long; and the *Ductus minor*, which regards the cavity of the *Tympanum*, has one orifice, which is near the *Ductus medius*, where it approaches the *Cochlea*, and near that the other orifice of the *Ductus major*; this is an inch long; The ſeventh pair of nerves, called in general, the auditory nerve, enters the *Proceſſus petroſus* and is divided into the *Portio dura & mollis*, as in other animals; in this ſubject one canule *e*, *b*, Fig. 8, 9. was found entering the bone from the ſides of the orifice for the carotid artery, about three lines in diameter; from thence running forwards for the

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the ſpace of an inch and four lines, it then bends downwards an inch, till it meets with the orifice, at the ſides of the *Meatus auditorius*, by which it pierces the ſcull, and paſſes outwards; after this canule has entered the bony proceſs for the ſpace of eight lines, it communicates with the orifice, which uſually enters the aforeſaid proceſs from the baſe of the ſcull; and both theſe orifices, after they have accompanied each other about five lines, are ſeparated, and the *Portio mollis* penetrates the bone at two places, as has been ſaid.

From this deſcription of the oſſeous part of the ear of this huge animal, we may at leaſt obſerve, what a variety of mechaniſm the great author of nature has thought fit to employ, in the ſeveral parts of the different ſpecies of animals; thus the external ear both of man, and the elephant lie flat, as being the moſt convenient poſition; for if they had been protuberant, as in moſt quadrupeds, how unſuitable would it have been in man, who is the moſt perfect of all creatures, not on account of his reaſon alone, but alſo as he is a pattern for beauty, and for the ſymmetry of his parts? And how unſeemly would it have been in the elephant, if his external ear had ſtuck out, and been proportionable to his other parts; conſidering, what an extraordinary aſpect he already makes by his trunk and tuſks? But the ears in theſe two ſubjects differ by the tortuoſity of the cartilage, and oblique *Meatus*, to prevent any injury from the air, by its immediate acceſs into the inner ear in man; whereas, in the elephant the external orifice is entirely expoſed to the air, but then the length of the *Meatus* hinders any more air, than is convenient, from arriving at the *Tympanum*. We likewiſe ſee in the ſeal, and otter, that thoſe two amphibious quadrupeds have no external ear farther protuberant, than the other parts of their head; for had it been otherwiſe, their ſwimming, and diving would have been much hindered; but its two ſides are ſo collapſed, that no water can enter in, when in the deep, tho' it may receive a ſufficient quantity of air, when aſhore; the cellulous cavity of the *Tympanum* in the elephant may well be compared to the *Apophyſis maſtoides* in man; and the ſecond cavity, which is of a plain ſurface, ſeems to be analogous to the cavernous *Apophyſis maſtoides* in ſheep, cats, dogs, *&c.* ſo that we ſee, that whereas other animals have but one cavity, for aſſiſting the vibration of the air, and continuation of the ſound in the *Tympanum*; this animal has two, or a large one with two different ſurfaces; the aqueduct both by its ſhape, and poſition in this animal, plainly ſhews us the uſe of it in other animals, which

is

is to receive the superfluous humours in the *Tympanum*, and convey them to be discharged into the mouth.

From the head Mr. *Blair* proceeds to the trunk, which consists of the spine, ribs and *Sternum*; the spine is divided into the *Vertebræ* of the neck, back, loins, *Os sacrum*, and tail; the first *Vertebra* of the neck, called *Atlas*, has four considerable cavities, *b b*, Pl. IX. Fig. 4. at the fore-part, whereby it receives the condyles of the scull; and two *c c*, at the back-part, whereby it receives the base of the following *Vertebra*; the first two are two inches and a half from the upper to the lower part, and two inches from right to left; it has a large hole in the middle, divided into its larger part *a*, three inches in diameter, which is for receiving the spinal marrow, and its lesser part, which receives the tooth of the following *b*; four perforations, or two pair of holes at the sides, one pair *c c*, at its lower and fore-part, which receives the cervical, or vertebral artery, from the side of the spinal marrow, and conveys it to a *Crena e e*, along which it runs, till it again penetrates the same bone *d d*, and goes out at the back-part; after which, in its progress, it perforates all the transverse processes of the rest of the *Vertebræ* of the neck, as is usual in other animals; this *Crena* is guarded on its outside, or at the extremity of the transverse processes, by a protuberance *a a*, which runs towards the scull half an inch, till it be in a line with the sides of the hole for the spinal marrow; at its upper and fore-part *f*, Fig. 5. it inclines obliquely, where it is three inches thick; and at its lower and back-part *e*, it has a protuberance, which is extended where it embraces the tooth; this *Vertebra* is in diameter 12 inches *a a*; the transverse processes are from the upper to the lower part two inches broad, and at their lower part three inches long: There is remarkable in the second *Vertebra*, 1. a large protuberance *d*, Fig. 7. called the tooth, which is received by a hole in the former, and serves as an axis, upon which the head is turned round; this tooth runs forwards from the body of the *Vertebra* two inches above, and two inches and a half below, tapering and terminating in an obtuse point. 2. A large protuberauce *a a*, Fig. 7, arising from its upper and middle part, like the spinal process in others; four inches from the beginning of the transverse processes, two inches broad at the top, and terminating in two obtuse points, with a *Sinus* (larger at the back than the fore-part) in the middle; this protuberance inclines forwards towards the first *Vertebra*. 3. Its body, or back-part and base of the tooth *f*, Fig. 8. which is transversely four inches and a half, and perpendicularly four inches. 4. Two ob-

oblique proceſſes *h h*, Fig. 8. whereby it is articulated, with theſe of the following *Vertebra*, and between which are four inches. 5. Two tranſverſe proceſſes *g g*, Fig. 7. each two inches long; at its fore-part *d*, on each ſide of the tooth are two protuberances *e e*, which are received by the two poſterior cavities of the firſt *Vertebra*; this *Vertebra* is two inches thick from the fore to the hinder part; the hole for the ſpinal marrow is two inches in diameter, thoſe for the cervical artery *f f*, are half an inch in diameter; between the oblique and the extremity of the tranſverſe is ſix inches: The third and fourth *Vertebra* differ from this. 1. In their four oblique proceſſes *e e* Fig. 9. 11. *viz.* Two by which they are articulated with the preceeding, and two with the following *Vertebra*, which is common to thoſe of the neck, back and loins. 2. In their convex body *b b* before, and concave body *c c* behind, where they are received by, and receive the preceeding and following *Vertebræ*, which is alſo common to the other *Vertebræ*. 3. In their eminences *e e*, at the top (between the oblique proceſſes) at four inches and a half diſtance, between which, there is a depreſſion in the third *Vertebra*, and a ſmall protuberance, anſwering to the middle of this depreſſion, in the fourth *Vertebra*; theſe tranſverſe proceſſes *f f*, are two inches broad at the extremity; from which they deſcend obliquely three inches, with a protuberance on each ſide; between which, and the body of the preceeding *Vertebra h h*, Fig. 20. proceeds a branch of the cervical artery, which it continues to do from between all the other *Vertebræ* of the neck, till it reaches between the ſeventh *Vertebra* of the neck, and firſt *Vertebra* of the back, where it is entirely ſpent; it is four inches between the oblique proceſſes *e e*, and tranſverſe proceſſes *f f*; the hole *d d*, for the cervical artery, is here oval; the bodies of theſe *Vertebræ*, are thiner below than the former; they are four inches in diameter, being of the ſame dimenſions with all the other *Vertebræ* of the ſpine, till you come to the *Os ſacrum*; thoſe in the neck are flatter before, and thoſe in the back more protuberant; beſides thoſe *Sinus*'s in the inſide of the above-mentioned protuberances in the neck, there is likewiſe a *Sinus* between the tranſverſe proceſſes of each *Vertebra*, and its body throughout the whole ſpine; for the tranſmiſſion of the ſeveral conjugations of nerves from the ſpinal marrow: The fifth *Vertebra* Fig. 13. is of the ſame dimenſions with the other two, and differs in nothing from them, but in its ſpinal proceſs, which from half an inch in the former, ariſes to an inch and a half in this, being half an inch broad, and thin at the extremity: The ſixth *Vertebra*

Fig.

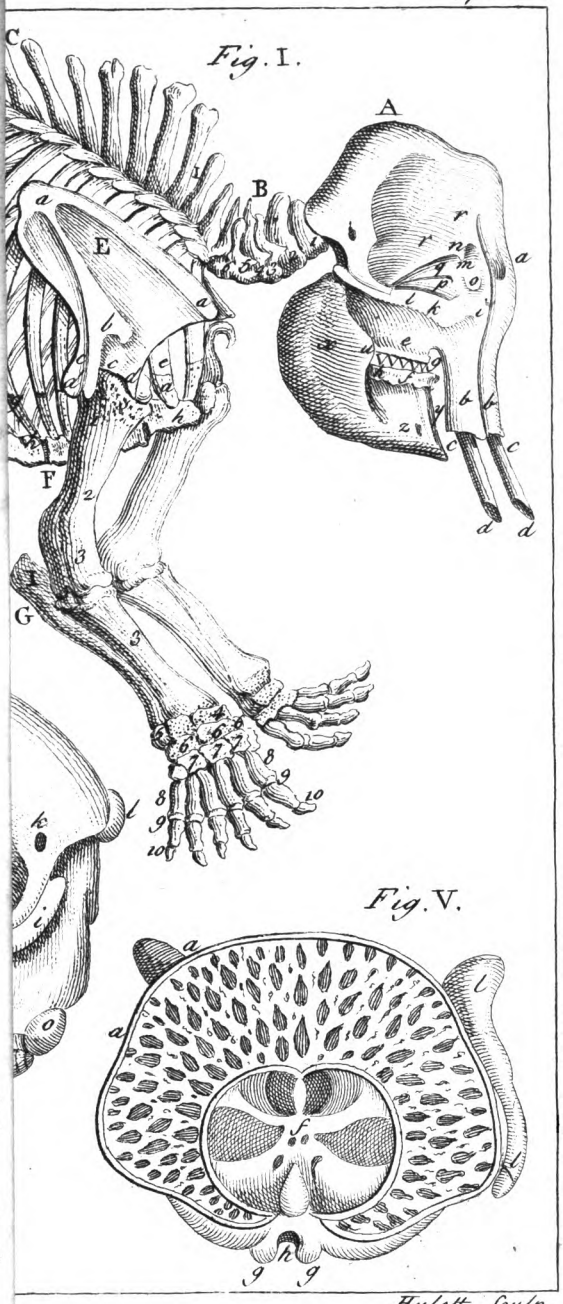

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Fig. I

Fig. VI.

Fig. X.

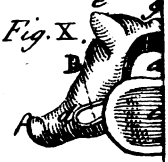

Fig. XV.

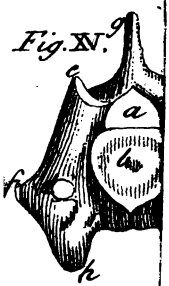

Fig. XXII.

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Fig. 15. differs from all the reſt in its tranſverſe proceſs, which runs as far forwards as the reſt, and ſends out another proceſs, which runs as far backwards; ſo that from the extremity at the fore-part to that at the back-part, it is three inches; it alſo ſends another protuberance *ii*, Fig. 20. obliquely outwards an inch and a half; at this proceſs the cervical artery paſſes out from the tranſverſe proceſs of the *Vertebra*, and only ſends a twig to the ſeventh or laſt *Vertebra* of the neck, which differs from all the reſt. 1. In the length of its ſpinal proceſs, *gg*, Fig. 17. 18. which is augmented from three inches in the former to five in this. 2. In the ſmallneſs of the hole *dd*, for the cervical artery, this being the laſt perforated tranſverſe proceſs, as has been ſaid. 3. In a *Sinus ii*, on each ſide of its body behind, into which it receives part of the firſt rib.

The *Thorax* is divided into the *Vertebræ*, ribs, and *Sternum*; there are 19 *Vertebræ*, correſponding to ſo many pair of ribs; they differ in nothing from the former, excepting that their body is more protuberant, that their ſpinal proceſſes are augmented, and diminiſhed in their length, according to their ſituation, and that they have a *Sinus* on each ſide, both before and behind, for the reception of their reſpective ribs; for the weight and dimenſions of their ſpinal proceſſes, ſee the following table: The ribs are divided into the true (which are articulated with the *Sternum*) and the falſe with and without cartilages; there are eight pair of true ribs, eight pair falſe with, and three without cartilages; the cartilages here are ſoft, as in human ſubjects, and not bony, as in oxen, harts, &c. The *Sternum* conſiſts of four bones; they are placed edgewiſe, being two inches thick above, and ſharp below; from the fore-part to the point of the *Cartilago enſiformis* 25 inches; whereof the firſt is eight inches long, and four inches and a half broad at the articulation of the firſt rib; the ſecond is four inches and a half long, and three inches broad; the third three inches and a half long and three inches broad; the fourth four inches long, and two inches and a half broad; the reſt of the length is made out by the *Cartilago enſiformis*: The loins conſiſt of three *Vertebræ*, whoſe ſpinal proceſſes are but ſhort; their tranſverſe proceſſes are a little longer than thoſe in the back; which beſides their weight (as in the table) is all that is remarkable about them: The *Os ſacrum* conſiſts of five bones; they are of a flat ſurface before, as repreſented by B, Fig. 21. 22. each having three proceſſes behind, *viz.* two oblique and one ſpinal, under which the ſpinal marrow deſcends; they are perforated before by four pair of holes, placed

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at their interſtices on each ſide; it is 12 inches long, and ſeven inches and a half broad, where it is articulated with the *Oſſa innominata* above, and ſix inches broad at the lower part: The tail conſiſts of 29 *Vertebræ*, whoſe differences are to be ſeen in the table; from the *Os ſacrum* to the eighth *Vertebra*, they have five proceſſes; *viz.* two tranſverſe, two oblique, and one ſpinal; under which the ſpinal marrow deſcends, ſending forth a conjugation of nerves from between each of them; from the eighth to the ſixteenth *Vertebra*, each has four proceſſes; *viz.* two longitudinal behind, between which the reſt of the ſpinal marrow ſtill deſcends, and two tranſverſe; the others have no proceſs at all, but are of a kind of quadrangular figure, with a ridge deſcending before, and behind, and on each ſide; being ſomewhat bigger at each end, and ſmaller in the middle; all the *Vertebræ* as well in the neck and back, as in the tail, had cartilages, running between each of them; they were about half an inch thick in the back, thiner in the neck, and proportionably thicker in the tail.

As this ſubject is a quadruped, Mr. *Blair* divides the extremities into the fore and hinder ones; he begins the fore extremities at the *Scapula*, Fig. 19; which is uſually divided into its head, neck, ſpine, proceſſes, fore and hinder cavities (*i. e.* theſe parts before, and behind the ſpine) its concave part, which lies upon the ribs, its convex, or outer part, and its margin; the head *a*, which receives the *Os Humeri*, is oblong (becauſe the motion of the *Humerus* performed by this animal, is rather flexion and extenſion, than adduction, or abduction) wherefore, the cavity being five inches and a half long, is only three inches and a half broad; and the margin of the bone, ariſing from the fore, and back part *bb*, makes it two inches deep; for at the ſides the margin is equal to the cavity; at the back-part there are two proceſſes; that which regards its convex part is two inches long, rugous, thick and obtuſe; and that which regards the concave part, runs two inches backwards; where it forms an obtuſe angle, and from whence it aſcends three inches to the neck; this has a ſharper edge than the former, being ſomewhat incurvated; between theſe two proceſſes is a rugous *Sinus*, two inches broad, aſcending from the cavity of the head three inches to the neck, and riſing ſomewhat in the middle of its progreſs; the neck *cc* is flat, being more obtuſe at its back-part, and where the laſt-mentioned protuberance is; and ſharper at its fore-part, whe e there is a ſmall protuberance towards the ſpine, on the convex ſide, being more plain on the concave ſide; between

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the first of the above-mentioned protuberances *b*, and the spine, there is a *Sinus d*, which ascends four inches; and from the same protuberance *b*, to the extremity of the coracoid process *e* is three inches and a half; this coracoid process is that part of the spine *e*, which runs towards the neck of the *Scapula*, but does not, as in men, defend the *Humerus* from dislocation; it is very rugous, and convex before, but concave at its back-part, being three inches and a half broad at the point, it ascends 11 inches, where it is raised five inches from the body of the *Scapula f*; it inclines a little backwards, and ascends 12 inches more, till it be lost, where the *Epiphysis g* begins, being still concave at the fore, and convex on the back-part; from the *Spina f* it sends forwards a production *h*, eight inches long, three inches broad at its upper-part, two inches about the middle, where it is crooked, and an inch and a half at its lower extremity, where it is thin, and sharp; but it is thicker and rugous, at its upper-part, concave on the inner, and convex on the outer side; this process serves to keep the *Musculi supra-spinati*, within their bounds, when they pull up such a vast weight, as the fore-leg; as the spine runs up five inches from this production, it is rugous and thick ou its edge; and from thence it becomes gradually thiner, 'till it comes to the *Epiphysis*; the back and upper part of the *Scapula* is very thin, and sharp from the neck *c*, 16 inches upwards to *m*; from thence it ascends five inches to the place where the spine ends, and forms a very rugous and spongy *Epiphysis*, thick at the upper end *l*; thence it descends obliquely two foot *i*; from whence its fore-edge being sharp, runs in obliquely towards the neck 10 inches, from thence it tends outwards, and descends five inches, till it comes to the neck; all the upper-part of the *Scapula*, from *m* to *l*, where it is thickest, and from *l* to *i*, where it is thinner, excepting towards its lower-part is covered with an *Epiphysis* (as has been said) spongy and rugous, which separated by boiling, and is a further argument that this animal was young, according to their term of life; it is otherwise a very thin bone and solid, excepting where the *Epiphyses* are.

The *Humerus* is a very irregular bone, its head it two foot in circumference, with two remarkable *Epiphyses*; one whereby it is articulated with the *Scapula* from the fore to the hinder-part, with a convex surface eight inches, and from right to left four inches and a half, and another on the outside rising higher, and sharp, about an inch aud a half; this *Epiphysis* is 11 inches round, and from the fore to the hinder-part with a flat outside

six

ſix inches and a half; between the *Epiphyſis*, which receives the *Scapula*, and this protuberance is a *Sinus* about three inches and half broad, and about an inch and half deep; as it deſcends towards the inſide it becomes deeper, and only two inches broad; it is deſigned for lodging the external tendon of the *Biceps*, analogous to a *Crena* for the ſame purpoſe in human ſubjects; the neck of the *Humerus* is 19 inches in circumference, flat behind for the ſpace of four inches, then forming an angle, and running obliquely outwards three inches, and then paſſing forwards below the outermoſt protuberance five inches, from thence croſſing the above-named *Sinus*, it runs back, firſt flat, then a little convex ſeven inches; below this outward protuberance there is a rugoſity for the inſertion of the *Flexores cubiti* ſix inches and a half long, and three inches and a half broad at the upper part; and from thence deſcending gradually, it terminates in a point; at the lower part of this rugoſity, the bone is 13 inches and a half in circumference, with three faces; one at its back part five inches broad, ſomewhat depreſſed from the inſide, then a little protuberant, as it tends outwards; a ſecond on the outſide, and four inches broad, and the third on the inſide, four inches and a half broad, alſo flat; here begins another conſiderable rugoſity, ſmall and oblique from the back-part of the outmoſt protuberance of the *Humerus*, and becoming very rugous at this place, continues ſix inches obliquely downwards, and two inches broad about the middle; at the lower-part of this rugoſity the bone is 18 inches in circumference, with its three faces otherwiſe diſpoſed; that which before terminated in an obtuſe ſpine, and where it was an obtuſe ſpine behind, now becoming flat; on the outſide begins a conſiderable *Sinus*, being a continuation of the *Sinus* formerly mentioned, between the *Epiphyſis humeri*, and the outer protuberance; whence in its deſcent, the bone became depreſſed; and now the *Sinus* 3, is conſpicuous, being formed by an obtuſe ſpine, deſcending obliquely forwards, from the aforeſaid rugoſity on the one ſide, and another obtuſe ſpine deſcending obliquely outwards on the other; this *Sinus* 3 is four inches broad from the fore to the hinder part; from thence meaſuring backwards, the bone is flat three inches and a half; and meaſuring from thence on the inſide, the bone having formed an obtuſe angle, is alſo five inches and a half flat; after the ſpine on the fore-ſide has deſcended five inches and a half, the bone becomes flat; that on the outſide terminating in a conſiderable protuberance, four inches and a half long, where the bone has only two faces, convex before, and concave behind, and 17 inches round; its aforeſaid outward protuberance

behind

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behind is seven inches; it becomes depressed an inch and an half in the middle, where the *Sinus* for receiving the *Cubitus* begins; from the aforesaid external protuberance, it descends in a streight line eight inches; and from its opposite part on the inside, it descends obliquely backwards five inches; and here the lower *Epiphysis* begins, where it is receiv'd by the *Cubitus* and *Radius*; this *Epiphysis* is a foot and ten inches and a half round, being three inches thick on the outside, and flat, and seven inches on the inside, and protuberant; between which behind, there is a considerable *Sinus* five inches and a half broad, and two inches and a half deep, and there is another *Sinus* before, seven inches broad, and of the same deepness; this *Epiphysis* is at its lower extremity, and on its inside, where it receives the *Cubitus*, five inches and a half from the fore to the hinder part; of a convex surface, and six inches on its outside, where it is received by the *Radius*; at its fore-part the *Sinus* is not very considerable, but at its back-part deeper, and narrower for receiving the *Olecranon*; at the extremity of the *Epiphysis*, it is narrower, being only six inches from right to left before, and seven inches and a half behind: The *Humerus* at its external part is thirty inches long, and at its internal part twenty six inches, with a large head, consisting of an *Epiphysis*, received by the *Scapula*; a large protuberance on the outside defending it from dislocation, and with a *Sinus* between the two, reaching a good way back, and from thence descending to its neck; from whence the bone becomes flat, 2, to about the middle, descending on the outside, also flat, with two rugosities for the insertion of the tendons; between this outside and back-part, there is a very large *Sinus* for the *Biceps*; which oblique situation, 3, is an admirable contrivance for adding strength, and conciliating a proper length to this muscle: Now the shape of the bone begins to be changed; for whereas formerly it reached from the fore to the hinder-part, now it reaches from right to left, and its lower extremity, 4, becomes broader, whereas at its upper extremity it was rounder.

The *Cubitus* and *Radius* are two bones of a singular figure, the one lying above the other; the *Cubitus* is 28 inches from the top of the *Olecranon* to its articulation with the bones of the *Carpus*, 5, Pl. VII. Fig. 1. the *Olecranon* 1 *s t*, from right to left, with a surface somewhat convex, is nine inches and $\frac{1}{2}$; and from the fore-part, where it is articulated with the *Humerus*, to its utmost point behind, in a streight line, seven inches;

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inches; this *Olecranon*, as it deſcends, becomes narrower by degrees, till it forms a ſpine, which runs obliquely forwards 13 inches, where it is contracted from the aforeſaid nine inches and ½ to three inches in breadth; afterwards the bone is enlarged on each ſide, till it forms a convex ſurface, which is received by, and articulated with the *Humerus*; this articulation is a *Ginglymus*, as in all other animals; *viz.* the *Cubitus* and *Radius* together receive the *Humerus* on the outſide before, which, on the inſide, the *Cubitus* does alone; between theſe two, there is a large protuberance, ariſing two inches and ½, which is alſo received by the *Humerus*; meaſuring from the extremity of the *Cubitus* and *Radius*, which receive the *Humerus* on the outſide to its oppoſite part on the inſide, including the back-part of the *Olecranon*, it is 10 inches; both the bones, from right to left, at the articulation before, are ſeven inches; then meaſuring round the *Cubitus*, below the articulation, it is 16 inches and ½; here the bone is flat before, from right to left ſeven inches; from thence obliquely backwards to the above-mentioned ſpine, beneath the *Olecranon* it is five inches on the outſide, and ſix inches and ½ on the inſide; at the lower part of the aforeſaid ſpine, the *Cubitus* is 11 inches in circumference; *viz.* flat before, four inches, where it forms an angle; from thence running obliquely backwards two inches, it forms another angle; and from thence an inch and a half obliquely backwards, where it is a little protuberant; and from thence again obliquely inwards it is three inches and a half; round the lower extremity of the *Cubitus*, and three inches above the *Epiphyſis*, it is 12 inches; *viz.* from the *Radius* two inches and a half, from thence obliquely outwards, with another flat ſurface three inches and a half; and from thence with a convex ſurface, round the back-part, it is ſix inches; the *Cubitus* at the *Epiphyſis*, from the *Radius* on the fore-part to its oppoſite ſide on the back-part, is 13 inches; from the upper part of the lower *Epiphyſis*, where it is articulated with the external bone of the *Carpus*, obliquely inwards, it is five inches; this *Epiphyſis*, with a convex ſurface behind, from right to left, is five inches.

The *Radius*, from the external and upper part of the *Cubitus*, on which it lies, and with which it is united, running obliquely inwards, is one foot, nine inches and a half in length; at its upper part it ſends a production outwards three inches and a half, by which, with a part of the *Cubitus*, it receives

receives the external part of the lower *Epiphysis* of the *Humerus*; from thence the bone is contracted at its fore-part to two inches and a half, then descending ten inches and a half, it becomes two inches and a half broad; from thence it enlarges gradually, till you come to the lower *Epiphysis*; where measuring from the fore-part of the *Cubitus* to its opposite and back-part, the *Radius* is eight inches and a half; from thence you descend three inches, to its articulation with the internal bone of the first rank or *Phalanx* of the *Carpus*; this bone is quadrangular above, and descending to about the middle, it becomes more convex; from thence it is gradually enlarged, and during the whole progress pretty free from the *Cubitus*; excepting where it is conjoined with it at its upper part; at the lower articulation, the one is only separated from the other by a cartilage; the lower *Epiphysis* of these bones is of a very unequal surface, and tho' not separated from them by boiling, yet plainly distinguished by their cartilages, which were not ossified.

The fore-part (or the hand in human subjects) consists of the *Carpus*, *Metacarpus* and fingers, or rather toes; the *Carpus* has six bones, disposed into two ranges or *Phalanx*'s, differing in shape from each other; rugous before, with several holes for the transmission of blood-vessels; and of a convex surface behind, with several inequalities for the insertion of tendons: The external bone, 1, Pl. X. Fig. 3. of the first *Phalanx* is an irregular bone, running forwards five inches and a half, with a convex surface, till it meet with its co-partner, and passing in a more direct line, it is three inches and a half behind; it has three faces; its upper view in the Fig. where it is articulated with the *Cubitus*, from the fore to the hinder part is two inches and a half, from right to left three inches and a half; at the fore-part it has a prominence, which is received by the *Cubitus*, from which the bone declines, as it runs backwards, and forms a depression about the middle, rising higher at the hinder part; at each side on the right and left, it receives the *Cubitus* by two superficial *Sinus*'s; its second face, whereby it is received by the second bone of this *Phalanx*, runs from the fore to the hinder part two inches and $\frac{1}{4}$; it is very narrow, and only touches its co-partner of the lower part; for between this and the other, there is a small cavity, whose surface, composed by both bones, is unequal for the insertion of tendons, and perforated with several holes for the ingress and egress of blood-vessels; its

lower ſurface is articulated with the outer bone of the ſecond *Phalanx* by a *Ginglymus*; *i.e.* behind, it has a *Sinus* for receiving that below it; about the middle, it has a ſmall prominence, which is received by the other, and both are conjoined by a plain ſurface behind; from the fore to the hinder part it is three inches, and from right to left four inches, being an inch and a half thick; it has three protuberances, one larger at its outſide, and more obtuſe; one leſſer below that, and more acute, and extending a little farther to cover a part of the outer bone of the ſecond *Phalanx*; and a third on its inſide towards its copartner; beſides theſe, it has another ſmall face, at its upper and back part, which runs two inches from right to left, and half an inch from the upper to the lower part, being likewiſe conjoined obliquely with the back part of the *Cubitus*; this bone weighed ſix ounces: The ſecond bone 2, of the firſt *Phalanx* is of the ſame thickneſs with the former, being articulated with the *Radius*, from right to left it is three inches before; at its middle it has a *Sinus* on each ſide; one towards the former forming with it the above-mentioned cavity; the other on its oppoſite ſide, where it receives the third bone of this *Phalanx*, ſo that here it is only two inches in diameter, and farther back but an inch and a half; from the hinder to the fore-part it is three inches, and behind, it is alſo articulated with the *Radius* by *Ginglymus*; for before, it is received by a ſmall production of the *Radius*, and about the middle it receives the *Radius*; this bone weighed five ounces: The third bone, 5, of this *Phalanx*, is only articulated with the former at the ſide, where it is received into the aforeſaid *Sinus*, above which it is alſo received by the *Radius*; it runs an inch and a half higher than the former, and as much lower; ſo that it is four inches and a half from the upper to the lower part, forming almoſt the whole inſide of the *Carpus*; it terminates above in an obtuſe point, from thence it becomes ſtill broader; ſo that it is three inches from its upper to its lower part; at its lower part it reſts upon the ſecond and third bone of the ſecond *Phalanx*; it weighed three ounces: The firſt bone, 3, of the ſecond *Phalanx*, on its fore and outer ſide follows the ſame progreſs with that above, being ſix inches from its hinder to its fore-part, where it is conjoined with its partner; and from its fore-part, at the articulation with its partner to its hinder part it is four inches; from right to left behind, where it is broadeſt, three inches; its ſurface behind is

unequal

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unequal for the reception of tendons; it is articulated above with the first bone of the first *Phalanx*, and with three bones of the *Metacarpus* below, and at its inside with its partner of the same *Phalanx*; its articulation above is by *Ginglymus*, as has been said; *i. e.* before and behind it is received by that above, and at the middle it receives; it is two inches and a half thick before; it weigh'd six ounces: The second bone, 4, which is much like it, as being received by the second above, after the same manner, is two inches on its convex surface, and two inches and a half transversely at its middle; at its outside, being the inside of the foot, it mutually receives the third bone, 6, which runs obliquely backwards two inches from the former; it has four surfaces for articulation; one where it is joined with the third bone of the former *Phalanx*, the second where it is joined with the last mentioned bone; in conjunction with the former it receives the fifth bone of the *Metacarpus*, and at its outside the sixth; it terminates in an obtuse point behind, and has a *Sinus* between the articulation of the bone of the *Metacarpus* and its extremity; the second weighed six ounces, and this four ounces: There are six bones in the *Metacarpus per Ginglymum longum*; *viz.* they are received above by the bones of the second *Phalanx* of the *Carpus*, and below by the toes; they are all much about the same figure, but not of an equal length; somewhat flat before, and convex behind; broader at the upper and lower extremity, where they touch each other, and narrower in the middle; the first on the outside is three inches long, and four inches and a half round its middle; and articulated with the external part of the outer bone of the second *Phalanx* of the *Carpus*; it weighed three ounces. The second is four inches long, and five inches and a half round its middle, flat before, and more convex behind, and articulated with the middle of the aforesaid bone of the *Carpus*, it weighed four ounces; the third is five inches long, also flat before, and 7 inches round its middle; it is articulated with the aforesaid bone of the *Carpus*, and possesses most of its inner surface; it weighed six ounces; the fourth is five inches long, and six round its middle; this possesses the largest part of the middle bone of the second *Phalanx* of the *Carpus*; it weighed six ounces; the fifth is four inches and a half long, and of the same bigness with the former, and possesses a part both of the middle and of the internal bone of the second *Phalanx* of the *Carpus*; and weighed four ounces; the sixth is three inches and a half

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long, and five inches and a half round in its middle, and poſſeſſes the external part of the ſecond bone of the *Carpus*; it weighed three ounces: Each of the toes of the fore foot conſiſts of ſix thick ſhort bones; whereof, the firſt of the external toe is five inches and a half round, and one inch and ¾ long; the ſecond about one inch broad, and half an inch long, weighing two ounces; the firſt bone of the ſecond toe is two inches long, and ſix inches and a half round; the ſecond is one inch and ¼ from right to left, and half an inch from the upper to the lower part, weighing three ounces; the firſt bone of the third toe is two inches long, and ſeven inches and a half round; the ſecond bone is divided into two in this ſubject; in ſhape not unlike an ox's hoof; and whether this be a *Luſus naturæ*, or peculiar to all other animals of this ſpecies, Mr. *Blair* could not determine; it weighed four ounces; the firſt bone of the fourth toe is two inches and a half long, and five inches and a half round; the ſecond bone is in ſhape not unlike the former, but not divided; from right to left it is two inches, and from the upper to the hinder part one inch, weighing four ounces; the firſt bone of the fifth toe is two inches and a half long, and four inches and a half round; its ſecond bone in ſhape reſembles the former, but leſs, and divided, weighing three ounces; the firſt bone of the ſixth toe is two inches long, and four inches and a half round, larger at its upper, and becoming narrower at its lower extremity; and with it a very ſmall bone is articulated; it weighed one ounce and a half: Beſides all theſe, there were two *Oſſa ſeſamoidea*, which were affixed to the lower part of the lower extremity of each bone of the *Metacarpus*; each about one inch long, half an inch broad, protuberant at the lower part, and concave at the upper part, or that ſide whereby they are articulated with the *Metacarpus*; and ſeparated from each other by a cartilage, which ran down in the middle of this lower *Epiphyſis* of the bone in the *Metacarpus*; theſe *Oſſa ſeſamoidea* were very uſeful for ſupporting the foot; for about their middle all the four hoofs of the fore-feet terminate; they weighed two ounces each.

The hinder extremities conſiſt of the *Oſſa innominata*, the thigh-bone, the two bones of the leg, and the foot: The *Oſſa innominata* Pl. IX. Fig. 21, 22. conſiſt, as in other animals, of two large bones, articulated behind with the *Os ſacrum* on each ſide, and before, with each other by *Synchondroſis*; each may be divided, as in human ſubjects, into the *Ilium*, or upper and external part; the *Os pubis*, or lower and fore-part, and *Iſchium*,

chium, or lower and back-part; tho' ſtrictly ſpeaking, theſe bones here ſhould only be divided into the *Ilium* and *Pubis*, there being no remarkable part about them, which can be called the *Ischium*; both theſe *Oſſa innominata*, joined together, form the *Pelvis*, Fig. 21, which is four foot ſix inches in circumference; from the *Os ſacrum* B above, to the upper part of the *Os pubis* C below, it is 18 inches, and from the right D to the left E 17 inches; the *Os pubis* at the articulation is from C above, to F below, 12 inches; between the two outer, and lower extremities of the *Ilium*, from the right G, to the left H, is three foot and a half; from the *Os ſacrum* above, along the margin of the *Os Ilium*, down to the afore-mentioned outmoſt point, is two foot, nine inches and a half G, H; and from that point H, to the *Acetabulum*, which receives the *femur* K one foot; this *Acetabulum* round its external edge is 18 inches in circumference; the breadth of the *Os Ilium* from the external edge H, to the ſide of the *Pelvis* E is 13 inches; round the neck of the *Ilium*, above the *Acetabulum* M, M, is 14 inches; the height of the *Oſſa innominata*, from the upper part of the *Ilium* to the *Acetabulum*, is 22 inches; the breadth of the *Os pubis* from the articulation with its partner, to the outſide N, N, is eight inches; the length of the oval hole for the *Muſculus marſupialis* O, O, is five inches and a half, its breadth four inches, and its circumference 13 inches; between the lower, and outmoſt extremities of the *Os pubis* behind, R, R, is 17 inches; theſe *Oſſa innominata* are flat before, ſtanding almoſt perpendicular with the two lower, and outmoſt extremities of the *Os Ilium* G, H, bending forwards, and having the *Os pubis* aſcending obliquely, convex before, where joined together, and concave behind; this aſcent of the *Os pubis* is a farther argument, that this is no retrocoiſent animal: The *femur* is three foot long, with its upper *Epiphyſis* 1, in circumference 15 inches; the neck below it is 13 inches; the breadth from the great *Trochanter* 2, on each ſide is 10 inches; below this *Trochanter* it is 18 inches in circumference; about the middle 12 inches; round above the lower *Epiphyſis* 16 inches; round the lower *Epiphyſis* itſelf 3, from the *Patella*, 4, on the outſide to the oppoſite part on the inſide 18 inches and a half; its diameter, where articulated with the *Tibia* behind, is ſeven inches, with two protuberances, whereof the external ear is two inches and a half, and the internal three inches and a half; the internal *Epiphyſis*, which is received by the *Tibia*, is from the fore to the hinder part ſeven inches, and the external five inches and a half;

half; the *femur* is in general, a long ſtreight bone, with a large round head (which in this ſubject, is ſeparated from its body by a cartilage, and this is ſtill an argument, that this animal was young) received by the *Oſſa innominata*, 1, a large *Trochanter* on the outſide, where the bone is broadeſt; from thence in its deſcent it becomes ſmaller, flat before, and behind, and thicker on the inſide than the outſide, and nearly of an equal bigneſs, till it comes to the lower extremity, where it is enlarged into two large *Epiphyſes*, which are received by the *Tibia*, with a *Sinus* in the middle about an inch deep, and as much in diameter; it ſends forth a large protuberance before, which is received by the *Rotula*, or *Patella*, a bone of a very rugous ſurface, conſiderably protuberant on the outſide, being from its upper to its lower part eight inches, and from right to left ſix inches; it is articulated with the *femur* by *Ginglymus*, with a cavity on each ſide, which receives, and a protuberance in the middle received by the *femur*: The *Tibia* is in length, meaſuring behind, 22 inches; its circumference at the upper *Epiphyſis* 19 inches, and at the neck 17 inches; it has a large depreſſion before, for facilitating the motion of the *Patella*; and is of a very rugous ſurface, for the inſertion of the *Extenſores tibiæ*; it is almoſt ſemicircular before, and flat behind; its circumference about the middle is 19 inches and a half, and at the lower extremity, where it again meets with the *Fibula*, and where it receives the *Aſtragalus*, 12 inches: The *Fibula* is 21 inches long, five inches and a half round above, where received by the *Tibia*, three inches about the middle, and five inches at the lower part, where it receives the *Tibia*; its *Epiphyſis*, which forms the external angle, or *Malleolus*, meaſuring from the fore to the hinder part along its outer ſurface, is five inches and a half: The bones of the hinder foot conſiſt of thoſe of the *Tarſus*, *Metatarſus*, and toes: The *Tarſus* conſiſts of ſix bones, whereof the firſt is called *Aſtagalus*, 1, Plate X. Fig. 4; this is articulated above with the *Tibia*, having a depreſſion in the middle three inches, which receives, and two protuberances at the ſides, which are received by the *Tibia*, three inches and a half; it receives the *Talus* below, with a ſurface four inches in diameter; on the inſide it ſends forth a large protuberance, and on the outſide both it and the *Talus* are received by the external *Malleolus* for the ſpace of two inches; before, it is received by the *Os naviculare* for the ſpace of four inches and a half; it weighed ſix ounces: The *Talus a* Fig. 2, is a very irregular bone; it is protuberant behind from the *Aſtagalus*

four

four inches and a half; this protuberance is in circumference at the extremity 10 inches, and at its neck eight inches; below, it is very rugous on the inside; it sends forth a protuberance, which is received by the *Astragalus*, as in human subjects; it has three remarkable surfaces; *viz.* one upon which the *Astragalus* rests, at its upper side; one at the fore-part, articulated with the *Ossa cuneiformia*, and the outside for the *Fibula*; it weighed one pound: The *Os naviculare* is 10 inches and a half in circumference; one inch thick, and concave behind, 2, Fig. 4, where it receives the *Astragalus*, and convex before with its different surfaces, 3; *viz.* one whereby it is articulated with the bone of the toe on the inside, and one for each of the three *Ossa cuneiformia*; it weighed four ounces: The bones of the second *Phalanx* of the *Tarsus* are called the three *Ossa cuneiformia*; two of which are articulated at the back-part with the *Os naviculare*, as was said, and the third partly with the *Talus*, and partly with the *Os naviculare*; each of them is about an inch thick; that on the inner side, 4, is the least, being from right to left an inch thick, it weighed an ounce and a half; the middle 5, two inches, weighed two ounces; and that on the outside, 6, three inches and a half, in weight three ounces; this last has two surfaces at the fore-part, whereby it is articulated with the two outmost bones of the *Metatarsus*; the middle bone of the *Tarsus* being only received by the middle bone of the *Metatarsus*: The external bone of the *Metatarsus* is very irregular; it is articulated behind with the external *Os cuneiforme*; where it is about two inches from the upper to the lower part; from whence (its external surface being very rugous) it becomes gradually smaller, being somewhat concave below, and protuberant above, till it terminates in a round extremity; it weighed two ounces and a half: The second is a short thick bone, eight inches in circumference and two inches and a half long; in weight two ounces and a half; this receives the first bone of the toe, which is four inches and a half in circumference, and two inches long; and receives the second bone of the same toe, being three inches in circumference and one inch, and a half long; larger at its upper, and smaller at its lower extremity, to which is affixed a small bone; these weighed three ounces and a half: The middle bone of the *Metatarsus* is the largest of all those belonging to the toe, being seven inches round, five inches long, and four ounces in weight; it receives the first bone of the toe, which is four inches and a half round, and two inches and a half long; to which is likewise joined another small bone to form

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from the extremity, both weighing four ounces: The two intermediate bones of the *Metatarsus* are thin, broad, and irregular; the first of which is two inches and a half broad, and two inches and ½ long; each weighing one ounce, to which also adheres a small bone, as in the former toe, but less; the second and last bone of the *Metatarsus* on the inside is two inches broad, and as much in length, thin like the former, with a small protuberance adjoined thereto instead of a toe; the bone of the fourth toe weighed one ounce and a half; and those of the fifth one ounce.

Tentzelius tells his friend, that in digging in a hill near *Erfurt* in *Germany* for a fine white sand, there were found several huge bones; at first mistaken for those of a giant; but upon trial, and the perusal of Dr. *Mullin*'s treatise, they were discovered to be the bones of an elephant; and that amongst the rest were found the head, 42 inches in diameter; two tusks, two spans and a half large, and eight foot long; four grinders, each 12 pound; the *Humerus* four foot, two spans and a half; the *Vertebræ* of the neck, each four spans in circumference, and two spans high; the *Os innominatum* two foot and a half long; with the head of the *Femur* inserted in the *Acetabulum*, and part of the *Tibia* 22 inches at the largest, and 17 at the smallest part; that they were obliged to dig 24 foot deep, before they could get out the head; that the bones lay in such a position, as shewed that the animal had been overwhelmed, or had great strugglings, while a-dying; *viz.* the left fore-foot stretched forwards to the side of the head, which lay towards the south, the right fore-foot inclining backwards under the body; the left hinder foot drawn in towards the body, and the right distorted here and there, out of its natural position; from all which *Tentzelius* concludes, that this was the largest elephant, that ever was seen in *Europe*; and that it could be brought thither by no other means, than the flood; both from the preternatural position of the body, and from the different *Strata* of earth lying above it, without the least sign of having been dug to bury it.

A table containing the particular dimensions of the *Vertebræ* and ribs, and the weight of all the bones of the elephant: And here observe, that the weight is 16 ounces to a *lib*; and the measure, according to the *English* yard, 12 inches to a foot, and 12 lines to an inch.

The

The *Vertebræ* of the back.

Numb.	Weight. lb.	oz.	dr.	Leng. of Spinal Proces. Inches.	Breadth of Extrem. Inches.
N° 1	2	4		8	2
2	2	2		12	3 1/2
3	2			13	4 1/2
4	1	5			
5	1	4	2	12	3 1/2
6	1	2	3	11 1/8	3
7		15	6	11	
8		14		10 1/2	2 1/2
9		14		10	
10					
11					
12		13		9 3/4	2
13				9	
14					1/2
15				6 1/2	1 1/2
16				6	2
17				5	
18			2	4 1/2	
19			4	3	
	20	8	7		

The *Vertebræ* of the tail.

Numb.	oz.	Length. Inch.	Breadth. Inch.
1	10	2	6
2	8		5 1/2
3			5
4	6		4 1/2
7			4
8	5		
9	4		3 1/2
10			3
11	3		2 1/2
13	2 2/3		
14	2 1/2		1 1/2
15			1
16	1 1/4		2 1/2
17	1		
18		1 3/4	
20		1 1/2	
21		1 1/4	
22		1	2 1/4

The Bones of the Head. lb.

Upper Jaw	66
Lower Jaw	45

The *Vertebræ* of the Neck.

Numb.	Weight. lb.	oz.	dr.	Length of Spinal Proces. Inch.
1	1	1 3/4		
2	1	6	4	
3		13	4	3/4
4		13	4	1/2
5		14	4	1 1/2
6		14	6	3
7	1			5
	7	10	6	

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Numb.	oz.	Length. Inch.	Breadth. Inch.
23 —	⅔ —	—	
24 —	—	—	2
25 —	½ —	½ —	1 ¼
—29 —	⅔ —	—	

The *Vertebræ* of the Loins.

	oz.	dr.	Inch.
1 —	13	4	3
2 —	12	7	
3 —	11		
	2	5	3

The Ribs.

Weight.			Length of Inner Surface.		Leng. between Extrem.		Breadth of Extrem.
lb.	oz.	dr.	Feet.	Inch.	Feet.	Inch.	Inches.
1	13		1	5	1	4	4
	12	4		9		8	3
1	1	2		11 ½		10	
	5		2	2	2		
	8	4		6		3	2 ½
	2	3				3 ½	
	1	5		8		3 ¼	2 ¼
	4	6		10		4 ½	
	3					5	
	15			9		3	
	14	4		7			
	13	4		5		1	
	12			4			
	10	6		½	1	11 ½	
	9					10	
	5	5	1	9		8	1
	5			8		7	
	3	2		5		4 ½	
	2	1					
16	15	6					
16	15	6					
33	15	4	Weight of Ribs				
4	2	7	1 *scrup.* Tail				

The

The Skeleton of the Elephant *consists of the Bones of*

	lb.	oz.	dr.	scr.	
The head divided into those of the					
Upper jaw, *viz.*					
Calvaria, or upper and back-part	1				
Frons, or upper and fore part	1				
Two *Maxillary* bones	2				
Two bones of the palate	2				
Two *Zygomatick* bones	2				
Two *Styloid* processes	2				
Two tusks	2				
Four grinders	4	66			
Lower jaw	1				
Four grinders	4	45			
	21	111			
The trunk composed of the *Spine*, consisting of the *Vertebræ* of the					
Neck	7	7	10	6	
Back	19	20	8	7	
Loyns	3	2	5	3	
Os Sacrum	5	4	0	0	
Tail	29	4	2	7	1
Ribs, 19 pairs	38	33	15	4	
Sternum	4	3	0	0	
	105	75	11	3	1
The fore extremities,					
Scapula	2	19	8	0	0
Humerus	2	16	0		
Cubitus and *Radius*	4	15	0		
Carpus, fix on each foot	12	3	12		
Metacarpus	12	3	4		
Toes	24	2	3		
Ossa Sesamoidea	24	0	6		
	80	60	1		

The

The hind-extremities	lb.	oz.	dr.	scr.
Ossa innominata, viz. *Ilion* & *Pubis*	2	28	0	
Femur, or thigh-bone	2	16	0	
Tibia and *Fibula*, or leg and spitbone	4	13	4	
Patella, or knee-pan	2	0	12	
Tarsus	12	5	10	
Metatarsus	12	1	6	
Toes	20	1	2	½
	54	66	2	½
Total Sum	260	312	14	7 1

This is the total sum of the weight of the bones.

Mr. *Blair* used the following method in mounting the skeleton; he caused an iron rod to be made, about the bigness of one for a bed, and of the length of the elephant, which was 14 foot from the forehead to the point of the tail; and this rod was passed in at the fore-part of the scull, above the hole for the root of the trunk, and ran back thro' the fore cellules, and passing along the lower-part of the seat of the brain, went out at the lower-part of the hole for the spinal marrow; and lest the inconveniency of its weight should happen to break the tender *Laminæ*, there was another rod of the same bigness, passed in at the one side of the head, where the depression is for the insertion of the muscles of the lower-jaw and *Proboscis*, and ran thro' the cellules at the side, going transversely along the lower-part of the seat of the brain, below the former, and passing out at the other side; by which means, this rod, from the right to the left, eased the burden of the other, in supporting the head on both sides, as the other rod did before; and lest any of these should slide out, he caused a piece of iron to be screwed on each extremity of that which passed from the right to the left, and on the fore-end of that which ran from the anterior to the posterior part; afterwards, the second *Vertebra* in the middle of its tooth, and all the other following *Vertebræ* were perforated in the center of their bodies; and to make the head still more steady, the base of the scull was twice perforated on each side of the hole for the spinal marrow; and a strong wire being passed thro' these holes, it ran from right to left above the rod, and kept it firm, lest it should have bended and suffered the head to incline too much downwards, by its weight

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weight: In order to join the lower-jaw, which is, perhaps the moſt ponderous bone in any land-animal, two wires were paſſed in, at about an inch diſtance from each other, running from above downwards, to that part *y*, Pl. VII. Fig. 4. of the baſe of the ſcull, which is for the reception of the condyles; and the ſaid two wires being paſſed thro' two holes, made from the fore to the hinder-part in the condyles themſelves, both their extremities were made to meet together at the upper and outer part of the condyles, and ſo twiſted, and made firm; and for further ſecurity, there was a wire brought round the margin of the large hole in the bone of the ſuperior *Maxilla*; which, being folded, was twiſted ſeveral times towards the proceſs of the *Corona b*, in the lower-jaw, where there were two latchets, or foldings of wire placed in the inner ſide; the folded wire from the *Os Maxillæ*, was brought in between them, and a pin was paſſed thro' all the three to be taken out at pleaſure; and farther, a folded wire was provided from the hinder to the fore-part in the *Symphyſis Menti h*, Plate VIII. Fig. 4. which paſſing in between the two *Oſſa Palati b*, Plate VII. Fig. 1. a pin was put a-croſs them, to be taken out at pleaſure, which was ſuch a relief to the condyles, that without making uſe of the wires running from the *Os Maxillæ* to the proceſs of the *Corona*, it was ſufficient to ſupport the weight of the jaw, and by pulling out the pin, the lower-jaw could be brought backwards and forwards: Being obliged to ſaw the ſcull, in order to take out the brains, there were two wires placed at the back-part of that, which is below the diviſion, for faſtening its upper part; into which were linked two other wires, which reached to that part above the diviſion, and were received into two foldings of wire, placed there on purpoſe; the ſame contrivance was alſo obſerved before; ſo that this upper-part might either be laid back, to ſhew the ſtructure and contrivance of the cellules, or taken quite off at pleaſure: Mr. *Blair* having matched the ribs in pairs, and fitted each pair of its *Vertebræ*, he cauſed each of their *Epiphyſes* to be twice perforated from the upper to the lower part (once towards the fore, and once towards the back part) and in like manner the tranſverſe proceſſes of the proper *Vertebræ*, oppoſite to the holes of the ribs; and then the extremities towards the *Vertebræ*, and the *Sinus* of the *Vertebræ*, correſponding to the rib, were perforated in towards its body; after which a wire two inches long was faſtened in the body of the *Vertebra* and extremity of the rib, and then both were brought together; which being done, the wires were put into their reſpective holes in the tranſverſe proceſſes, and ribs;

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and both the ends of the two laſt wires being brought together at the upper-part, and interſtice between the ribs, and tranſverſe proceſſes, were twiſted, and made firm; this was done thro' all the 19 pairs; afterwards he provided ſome jumps, and after moiſtening and beating this leather, it was ſhaped according to the bigneſs of each *Vertebra*, perforated in the middle, and put alternately on the rod; firſt the *Vertebra*, and then the leather, to ſupply the defect of the cartilages (which were all loſt in boiling) and beat ſo cloſe, that the oblique proceſſes of the *Vertebræ* might meet; this was continued till all the *Vertebræ* were on the rod, all along to the *Os ſacrum*; and becauſe the firſt *Vertebra* was not perforated with the rod, there was a wire paſſed betwixt the ſcull and it, on each ſide, that it might not remain looſe, but be fixed to the condyles, by twiſting and making faſt the wire: The *Oſſa innominata* having been disjoined in boiling, both before or below, at the *Os pubis*, and above, or behind, at the *Os ſacrum*, Mr. *Blair* paſſed two rods of iron tranſverſely from the one ſide (the one above and the other below) thro' the *Os ſacrum* to the other; theſe were rivetted on the back-ſide at both ends; and then perforating the *Os ſacrum* from above, downwards thro' the middle of its body, it was alſo put upon the rod for the ſpine; afterwards he proceeded to put on the bones of the tail, and their mock cartilages alternately, as they followed in order, till all the rod was filled, and on its extremity another piece of iron was ſcrewed, to keep all firm and ſecure: Afterwards a large wire was paſſed from the fore to the hinder-part of the *Sternum*, whereby all its bones were fixed to each other; and to them were joined pieces of bend-leather to ſupply the cartilages; theſe Mr. *Blair* fitted to the articulation, of each rib, to which they were joined; and perforating the extremities of the ribs twice, he paſſed two wires between the mock cartilages and them, bringing the two ends together, and twiſting and faſtening them on the inſide, by which all the *Thorax* was mounted; and leſt the ribs thus fixed at both extremities, ſhould be too ready to move from the fore to the hinder part, and *è contra*, each of them was perforated above, towards the back, and below towards the belly, for receiving the foldings and latchets of wire to be faſtened therein; then he procured two large wires, each folded twice the length of the *Thorax*; one of which being paſſed thro' the laſt rib, and its two parts brought together, were twiſted ſeveral times, till it was brought oppoſite to the latchet in the next rib; within which the one part was paſſed, the other remaining without, and then twiſted again, till

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it came to the third rib; and ſo on throughout the whole ribs, both above and below, to keep them firm, and at a due diſtance: Next, Mr. *Blair* took the two *Scapulæ*, as belonging to the upper extremities, and perforating both of them oppoſite to each other at their upper margin, he paſſed a pretty large wire thro' one of the perforations; which being folded, was twiſted for the ſpace of 20 inches; *i. e.* from the *Scapula* on the one ſide, ſtrait over the back, paſſing in between two of the *Vertebræ*, till it came to that on the other, where it was faſtened; afterwards both the *Scapulæ* were faſtened, by paſſing two folded wires from the outſide of each *Scapula*, thro' the firſt and third ribs, in whoſe inſide they were fixed; then the head of the *Scapula* was perforated thro' the margin, which guards the *Humerus* at the fore, and back-part: The head of the *Humerus*, oppoſite to the middle of the concave part in the *Epiphyſis* of the *Scapula* was perforated four times, twice towards the inſide, and twice towards the outſide; into which were put two folded wires, whoſe extremities were fixed below at the aforeſaid inward and outward part, and into their foldings a large pin was paſſed from the margin of the *Scapula* on the one ſide, to that on the other (to be pulled out at pleaſure) for ſuſpending the *Humerus*: The *Cubitus* and *Radius* were joined with the *Humerus* in this manner; the *Cubitus* was perforated twice in the back-part, at the beginning of the *Olecranon* on each ſide; where two ends of wire being rivetted, were brought thro' the upper-part of the ſaid *Olecranon*, and then twiſted till they came to the *Humerus*; which was perforated from the back-part, where the depreſſion is for receiving the *Olecranon*, to the fore-part above the *Epiphyſis*, received by the *Cubitus* and *Radius*; thro' theſe holes, made pretty large, the wires thus twiſted were paſſed; the one to the *Radius* on the outſide, and the other to the *Radius* on the inſide; where they were introduced, and brought out at the back-part of the *Cubitus*, below the *Olecranon* on each ſide, where their extremities were rivetted two inches and a half below their inſertion; by which means the flexion and extenſion could eaſily be ſhewn; the lower *Epiphyſis* of both *Cubitus* and *Radius*, being ſeparated by boiling, he perforated each of them below, towards the *Carpus*, and paſſed a wire obliquely upwards, to ſecure them; and becauſe the *Radius* is diſtinct from the *Cubitus* below, there was a wire paſſed from the one to the other, and rivetted at each outſide: The *Cubitus* was perforated twice in the back-part of the *Epiphyſis*, about an inch above the articulation with the bone of the *Carpus* on the outſide, and in like manner the *Radius* in the inſide,

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inſide, and back-part; both which perforations were continued thro' the two bones of the firſt phalanx of the *Carpus*; afterwards the external bone was perforated a third time, all which ran from the upper to the lower-part, to the firſt, ſecond, and third bones of the ſecond phalanx; which being done, two folded wires were paſſed in at the four holes of the back-part of the *Cubitus* and *Radius*, where there duplicatures were formed; and the fifth wire put into the hole, made in the middle of the external bone of the firſt phalanx of the *Carpus*, was continued with the reſt thro' the bones of the ſecond phalanx, to thoſe of the *Metacarpus*, where they ran from one extremity to the other; that is, the outer part of the folded wire from the *Cubitus*, ran down the outſide of the external bones of the firſt and ſecond phalanx of the *Carpus*, to the external bone of the *Metacarpus*, all along, till it was brought out at the extremity of the furtheſt bone of the toe, belonging thereto; and the inner part of the ſame wire, paſſing from the *Cubitus* thro' the ſame two bones of the *Carpus*, ran down to the third bone of the *Metacarpus*, from the outſide; from whence it was conveyed to the extremity of its toe, and there rivetted; the third wire paſſed from its entry, in the middle of the external bone of the firſt phalanx of the *Carpus*, to that of the ſecond; and from thence down to the ſecond bone of the *Metacarpus*, from the outſide, to the extremity of its toe, where it was faſtened; and the folded wire from the back-part of the *Radius* paſſed down at two places, thro' the middle bone of the firſt phalanx of the *Carpus* to that of the ſecond phalanx; and from thence to the fourth and fifth bones of the *Metacarpus*, from the outſide, and ſtill forwards to the extremities of their toes, where they were fixed; afterwards he cauſed the external bones of the *Carpus* to be perforated twice; *i. e.* towards their fore and back-part, as alſo the *Metacarpus* at the upper and lower extremity; paſſing the drills from the outſide to the inſide of each bone, or from right to left, by which the bones above were as well joined with their ſides, as with thoſe below them; ſo that each was kept ſecure in its place, eſpecially the bones of the *Metacarpus*; ſince the third bone of the firſt phalanx of the *Carpus*, lies as it were, at the ſide of both phalanxes, he therefore paſſed the two ends of the wire, which ran from right to left, in the firſt phalanx, that ſo it might be faſtened with its partner on the inſide; and ſince the external bone of the *Metacarpus* ſtill remain'd to be joined, the inner bone of the *Carpus* was perforated again, and a wire brought from it to the inner bone of the ſecond phalanx; and from thence to the ſaid bone of the *Metacarpus* with its

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its toe, where it was fastened: The upper *Epiphysis* of the *Femur* being also separated by boiling, he perforated its head four times, for the immission of two folded wires, which were brought obliquely down the inner and outer side to its neck, where their extremities were twisted and secured; it was afterwards perforated four times in the middle, for two other folded wires, which were twisted once or twice, and their extremities put thro' the aforesaid holes to the inner and outer part of the neck of the *Femur*, as before, there to be made fast; the *Acetabulum* was perforated in the bottom, and these two foldings passed thro' it; into which there was put a pin, at the back-part of the *Ossa innominata*, to be pulled out at pleasure, and the thigh suspended as the *Humerus*: Two folded and twisted wires were passed in at the *Epiphysis*, on each side of the spine in the middle of the *Tibia*, and their extremities were brought out at its upper, and back-part, where they were rivetted; afterwards, the lower *Epiphysis* at the *Femur* was perforated from right to left, and a pin passed from the outside, thro' the foldings of the wires from the *Tibia*, to the inside (whereby the flexion and extension was most conveniently shewn) to be taken out at pleasure; the *Perone* was fixed to the *Tibia* at the upper part, by a pin passing obliquely upwards from the one to the other; and the *Patella* was fastened to the fore-part of the *Femur*, by a pin passing directly inwards from the fore to the hinder-part; the lower-part of the *Perone*, forming the external *Malleolus*, was perforated from the outside to the inside, as was also the opposite part of the *Tibia*, forming the internal one; the *Astragalus* was in like manner perforated from right to left, corresponding to these two holes, for the immission of a pin, whereby the foot was joined to the *Tibia*, to be pulled out at pleasure; the *Astragalus* was joined to the *Talus* by a pin, passing from the upper and middle-part of the one, to the lower-part of the other, where it was rivetted; the *Astragalus* was thrice perforated before, into two of which holes a folded wire was passed, which went forwards thro' the *Os naviculare*, to the bones of the *Metacarpus* of the second and third toe from the inside, at whose extremities they were fixed; the third wire ran from the *Astragalus* to the *Os naviculare*, and the third *Os Cuneiforme*, to the fourth toe; the said *Os naviculare* was perforated on the inside for a wire, which ran thro' the bone of the *Metacarpus* and inner toe; the third *Os cuneiforme* was perforated for a wire, which passed thro' the bone of the *Metacarpus*, and outer toe; the three *Ossa cuneiformia* were joined to each

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other by a folded wire, which ran twice from their outside to their inside, where they were secur'd.

As to the structure of the bones, *Tentzelius* says, *omnia isthæc Ossa porosa sunt & rimosa*; and Mr. *Blair* adds, *levia*; for they have nothing of that solidity and compactness, that smoothness of surface, and that whiteness, which is observable in other quadrupeds of the larger size, as oxen, horses, harts, *&c.* nor even in the smaller, as sheep, dogs, cats, *&c.* And Mr. *Blair* would have readily attributed this to the youth of the animal, had not *Tentzelius* affirm'd the same of his subject, suppos'd to be 200 years old; and this differs much from the account of the *Behemoth* in *Job*, whose *bones* are said to be *as strong pieces of brass and bars of iron*; the *Laminæ* of the head were thin and solid; the external table thin and more ponderous; the teeth exceeding solid and ponderous; so that from the computation of the weight of the upper part, which was taken off by the saw, as in Pl. VII. Fig. 6. and Pl. VIII. Fig. 1. which is only six pound weight, we may reckon all the head, which weighed 66 pounds, besides the teeth, not to weigh above 24 pounds at most; which agrees well with what *Tentzelius* affirms, that each of the *Dentes molares* was 12 pound weight; and that, of all the 45 pounds, which the lower jaw weigh'd, the rest of the bone, besides the grinders, did not exceed 12 or 16 pounds; for its external surface seem'd to be both porous and rimous, as has been said; and in perforating, the condyles seem'd to be very spongy; as also the ribs, *femur*, *tibia*, *&c.* where, after the drill had passed the external *Lamina*, which was very thin, it would have run forwards, as if it had been thro' so much moss; when the *Epiphysis* came off the thigh-bone, it very much resembled the *Epiphysis* of the *Femur* in man; its minute cellules were not so big as those of an ox, and the *Laminæ* which circumscribed them, not so solid by far; the *Humerus*, indeed, both above and below, was much harder, and heated the drill in passing; and the reason may be, that the progression of most quadrupeds chiefly depends upon a more frequent motion of the fore than hinder limbs, and it does so much more here, where the head is proportionably heavier than in other animals; and this perhaps is the reason too, why the fore-limbs in this animal are brought so far forwards; for measuring in a streight line from the *Humerus* above, to the *Carpus* below, and bringing another line directly back-

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backwards at the articulation between the *Humerus* and *Cubitus*, from the perpendicular line before, to the point of the *Olecranon* behind, it was 20 inches: The bones of the *Carpus* were pretty ſolid, and by perforation ſeemed to have a little ſpongioſity only about the middle; all the reſt of the bones of the fore-foot were ſpongy; the *Aſtragalus*, *Os naviculare* and *Oſſa cuneiformia* were more ſolid; but the *Talus*, and other bones of the hinder-foot were ſpongy; the ſpine was ſpongy, as is uſual; the *Oſſa innominata* of a middle conſiſtence, and the *Scapula* very thin, but ſolid towards its neck: Mr. *Blair* could not poſitively determine the cavities for the marrow, nor the quantity thereof; but, by comparing the dimenſions with the weight and ſmall quantity of fat to be ſeen at the boiling, we may ſuppoſe it not to have been very conſiderable in this animal; and he does not know how it may be in others of this ſpecies: When Mr. *Blair* weighed the bones, it was immediately before they were joined; ſo that their weight was much diminiſhed, in reſpect of what it was when they were newly boiled.

Pl. VI. Fig. 20. repreſents the ſtuffed skin of the elephant, as it now ſtands at the hall at *Dundee*, with an account of its dimenſions; A A, the height of the elephant at the fore-feet was eight feet ſix inches; B B, its height at the hinder-feet was nine feet; C C, its length, ten feet; C D, the length of the tail, four feet three inches; E E, the circumference of the belly, fourteen feet; F F, from the top of the head to the point of the *Proboſcis*, eight feet; G F, the length of the *Proboſcis*, four feet ſix inches; H H, the diſtance between the forehead and lower jaw, two feet three inches; F I, from the top of the head to the lower jaw, four feet ſix inches; K K, the length of the ear, one foot ſeven inches; L L, its breadth, one foot five inches; M, the orifice of the *Meatus auditorius*; N N, the circumference of the fore-foot round the hoofs, three foot, ten inches, and a half; *a*, the fore-hoof ſhortned, five inches; *b*, the middle external hoof, five inches; *c*, the third external hoof, four inches and a half; O O, the circumference of the fore-foot at the upper joint, four feet three inches; P P, at the articulation with the *Carpus*, two feet ſix inches and a half; Q Q, the circumference of the hinder foot round the hoofs, three feet four inches; the diameter, from before to behind, ... ; from the right to the left, ... ; *a*, the breadth of the fore-hoof, three

inches; *b*, the breadth of the outer hoof, four inches; *c*, the breadth of the third hoof, four inches; R R, the circumference of the hinder leg, two feet two inches; S, the mouth; T, the tusks broken off at the middle; U, the eye; X, repreſents the ſcabs about the belly; Y Y, the depreſſions in the ſkin, thro' the folding of the *Proboſcis*; *a*, a protuberance firſt occaſioned by the *Oſſa innominata*, when the animal was alive, and very lean, and ſtill remaining in the ſkin; *b*, a protuberance in the fore-part of the thigh; *c*, the lower joint of the fore-foot, where there is a depreſſion in the ſkin; *d d*, ſeveral wrinkles in the ſtuffed ſkin.

Pl. VII. Fig. 1. repreſents the ſkin of the elephant, as it was mounted by Mr. *Blair*, and now ſtands in the repoſitory of rarities at *Dundee*; A, the ſcull taken in profile, whereby a part of the fore-ſide is fore-ſhortned; *a*, the hole for the root of the trunk fore-ſhortned; *b b*, the two *Oſſa palati*; *c c*, the two tuſks, as they proceed from the *Oſſa palati*; *d d*, the extremities of the tuſks broken off; *e*, the grinders of the upper jaw; *f*, the fore-grinder of the lower jaw; *g*, the undulating lines of the lower ſurface of the grinders of the upper jaw; *h*, the inner grinder of the lower jaw; *i*, part of the *Os malæ*; *k*, its articulation with the *Os zygomaticum*; *l*, the *Os zygomaticum*; *m*, the orbit of the eye; *n*, its upper protuberance; *o*, its middle protuberance where the *Trochlea* is inſerted; *p*, its lower protuberance; *q*, a *Sinus* at the bottom of the orbit; *r r*, a depreſſion fit for lodging the muſcles of the lower jaw and *Proboſcis*; *s*, the orifice of the *Meatus auditorius*; *t t*, the articulation of the *Os calvariæ* with the *Os zygomaticum*; *u*, the *Proceſſus coronæ* of the lower jaw; *x*, the inſertion of the *Muſculus maſſeter*; *y*, the ſpace for the mouth between the *Os palati* and lower jaw; *z*, an orifice, from which the *Nervus maxillaris inferior* proceeds; B, the *Vertebræ* of the neck; 1, the firſt *Vertebra*; 2, the ſecond *Vertebra*, or tooth, which riſes higher than the reſt; 3, the third *Vertebra*, with ſcarce any ſpinal proceſs; 4, the fourth *Vertebra*, whoſe ſpinal proceſs is not yet ſeen; 5, the fifth, with the ſpinal proceſs beginning to appear; 6, the ſixth, whoſe ſpinal proceſs aſcends higher, and is remarkable at its fore-part, as in Pl. IX. Fig. 15, 16; 7, the ſeventh, whoſe ſpinal proceſs ſtill aſcends, and with whoſe back-part the firſt rib is articulated; C, the *Vertebræ* of the back; 1——13 their ſpinal proceſſes, which have no protuberance at their extremity

extremity, whereof 1——C are the longeſt, and C——13 become gradually ſhorter; D the ſpinal proceſſes of all the reſt of the *Vertebræ* to the *Os ſacrum*, which are ſhortened by degrees; *x x x x x*, &c. the oblique proceſſes of the *Vertebræ*; E the *Scapula*; *a a* the ſpongy margin of the *Scapula*; *b b* its *Proceſſus ſpinoſus* ſending forwards a protuberance; *c c* its neck; *d d*, the *Epiphyſis*, which receives the *Humerus*; *e e*, &c. the ribs; *f f*, &c. the ribs which appear on the oppoſite ſide; *g g* the cartilages of the *Sternum*; *h h* the bones of the *Sternum*; *i i i* the three ribs which have no cartilages; *l l l* the bodies of the three *Vertebræ* of the loins; F the *Humerus*; 1, its upper part, ſpongy and rugous, for the inſertion of tendons; 2, its middle part more ſolid; 3, a large oblique *Sinus* for lodging the *Biceps*; four its lower extremity articulated with the *Cubitus* and *Radius*; G the *Cubitus* and *Radius*; 1, the *Olecranon*; 2, an hollowneſs on the outſide of the *Cubitus*; 3, the *Radius*; 4, its lower *Epiphyſis* rugous, and ſeparated from it by a ſuture; 5, the lower *Epiphyſis* of the *Cubitus* ſeparated likewiſe by a ſuture; 6, 6, 6, three bones of the firſt phalanx of the *Carpus*; 7, 7, 7, three bones of the ſecond phalanx; 8——8, the bones of the *Metacarpus*; 9——9, the firſt bones of the toes; 10——10, the ſecond bones of the toes; H H the *Oſſa innominata* repreſented in profile; I the *Pelvis*; K the tail; L L the two thigh bones; 1, the *Epiphyſis* received by the *Oſſa innominata*, and articulated with the *Femur* by a ſuture; 2, the *Trochanter major*; 3, the lower *Epiphyſis*; 4 the *Patella*; M the *Tibia*; 1, the *Perone*; 2, the *Talus*; 3, the bones of the *Tarſus*; 4, the bones of the *Metatarſus*; 5, the bones of the toes.

Fig. 2. repreſents the fore-part of the head; *a* the hole for the root of the trunk; *b* the lower part of the *Os palati*, over which hangs the *Proboſcis*; *c c* a depreſſion of the bone on each ſide, for lodging the muſcles of the lower jaw; *d d* the two eminencies on each ſide at the top of the head; *e* a depreſſion in the middle between theſe two eminencies; *f f* two beginnings of the angles, for forming the depreſſions for the muſcles of the lower jaw; between which the ſurface of the bone begins to be plain; *g* the upper production of the *Sinus*, where the eye is lodged; *h* the beginnings of the *Laminæ*, which run between the two tables of the ſcull, and here appear in the bottom of the hole for the root of the *Proboſcis*; *i* the *Os vomeris*, to which the cartilaginous *Septum* of the *Proboſcis* adhered; *k* the beginning of the depreſſion of the *Os palati*; *l* the middle of the *Sinus* for the orbit of the eye; *m* the articulation of the two *Oſſa palati*;

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lati; *n n* the articulation of the *Os maxillæ* with the *Os palati*, where there is alſo a *Crena* for containing the blood-veſſels, as they go to nouriſh the *Proboſcis*; *o o* the place where the tuſks proceed from the *Os palati*; *p p* the upper part of the articulation of the *Os maxillæ* with the *Os palati*; *q q* the broken extremities of the tuſks; *r r* a large oval hole in the *Os maxillæ*, thro' which a conſiderable branch of the fifth pair of nerves, and a large artery from the artery of the *Dura mater* paſs to, and are diſperſed in the *Proboſcis*; and by which a large vein returns, and joins the jugular vein; *s* the *Os zygomaticum*; *t* the middle production for the orbit of the eye.

Fig. 3. repreſents the ſide of the head; *a* the beginning of the depreſſion for the muſcles of the lower jaw and *Proboſcis*; *b* the inſertion of the *Retractores* of the *Proboſcis*; *c* the inſertion of the temporal muſcle; *d* the bottom of the orbit of the eye; *e* its upper production; *f* its lower production; *g* the articulation of the *Os maxillæ* with the *Os zygomaticum*; *h* the *Os zygomaticum*; *i* the articulation of the *Os zygomaticum* with the *Os cavalriæ*; *k* the orifice of the *Meatus auditorius*; *l* one of the condyles of the *Occiput*, which is articulated with the firſt *Vertebra*; *m* the orifice of the large oval hole in the *Os maxillæ*; *n* the fore grinder of the upper jaw; *o* the hind grinder, or rather wedge for keeping the fore grinder faſt; *p* the undulated lines in the lower ſurface of the teeth; *q* the beginning of the tuſks, as they proceed from the *Os palati*; *r* their extremities broken off; *s* the *Sinus* in the bottom of the orbit of the eye for the optic nerve.

Fig. 4. repreſents the back part of the head; *a a* the two eminencies at the upper part of the head enlarged, whereby the *Sinus* between them becomes narrower, and deeper; *b* the *Sinus* between theſe eminencies ſhortened; *c c* the two condyles, received by the firſt *Vertebra*; *d* the hole for the ſpinal marrow; *e e* two protuberances above the *Meatus auditorius*; *f* the orifice of the *Meatus auditorius*; *g* a *Sinus*, whence the ſtyloidal proceſs ariſes, which is ſhewn by itſelf; *h* the cartilages whereby the ſtyloid proceſs is articulated with the ſcull; *i* its longeſt and ſmalleſt part; *k* its ſhorteſt and biggeſt part; *l* the orifice for the *Portio dura*; *m m* the hole for the jugular vein, and *Par vagum*; *n n* the bony part of the aqueduct; *o o* the extremity of the aqueduct, where the fleſhy part begins; *p p* the hole for the carotid artery; *q q* the hole for the artery of the *Dura mater*, and third branch of the fifth pair; *r* the middle of the baſe of the ſcull beneath the hole for the ſpinal marrow, where the

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the bone is somewhat raised; *s* a depression on the base of the scull before the *Choana* begins; *t* the *Choana*, or passage between the root of the trunk, and the mouth; *u* a production of the *Vomer*, or *Septum*, which divides the *Choana* in two; *x* the articulation of the *Os zygomaticum* with the *Os Occipitis*; *y* the glenoid cavity for the reception of the lower condyle of the lower jaw; *z* the *Sinus* for the globe of the eye; 1 the *Os zygomaticum*; 2 the fore grinder on the right side; 3 the hind grinder on the right side; 4 the hinder teeth on the left side, which do not grind, but serve for a wedge; 5 the fore teeth on the left side, the back part of which does not grind; 66 the lower surface of the grinders, where their undulated lines appear; 77 part of the *Os maxillæ*, where it is articulated with the *Os zygomaticum*; 88 the large oval hole in the *Os maxillæ*; 99 the back part of the *Os palati*; 10 the interstice between the *Ossa palati* on the back side; 11 11 the tusks as they proceed from the *Os palati*; 12 12 the two extremities of the tusks broken off.

Fig. 5. represents the scull sawed transversely, so that its lower part, together with the base appear; *a a* the outer table of the scull; *b b* the inner table, *c c* the *Laminæ* which pass between the two tables; *d d* the cells formed by these *Laminæ*; *e e* the orifices for vessels, which penetrate the *Laminæ*; *f* the seat of the brain, represented more at length in Fig. 4; *g g* the two condyles, received by the first *Vertebra*; *h* the hole for the spinal marrow; *i* the *Os zygomaticum*.

Fig. 6. represents the upper part of the scull sawed transversely with the cells, running between the two tables, and *Laminæ*, which cover the seat of the brain.

Plate VIII. Fig. 1. represents the outside of the upper part of the scull, sawed transversely; *a a* two eminencies on the top of the scull; *b* a *Sinus* between these two eminencies; *c* a long spine in the bottom of the *Sinus*.

Fig. 2. represents the fore part of the lower jaw, *a a* the two condyles; *b b* the two processes of the *Corona*, shortened by the opposite view; *c c* the fore grinders of the lower jaw; *d* the distance between the two jaws for lodging the tongue; *e* the *Symphysis menti*.

Fig. 3. represents the back parts of the lower jaw; *a a* two condyles; *b b* two large orifices of a cavity, into which the vessels for nourishing the teeth enter, and wherein are lodged the rudiments of the teeth, as in Pl. IX. Fi. 1. *c c* the two fore grinders of the lower jaw; *d d* the undulated lines in their upper surface; *e* the

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e the distance between them for lodging the tongue; *f* the concave part of the lower jaw.

Fig. 4. represents one side of the lower jaw; *a a* the two condyles; *b b* the two processes of the *Corona*; *c* a protuberant part of the lower jaw, where the rudiments of the teeth are lodged; *d* the inner grinder of the lower jaw; *e* the outer grinder, where the ridges and interstices of the sides of the teeth are represented; *h* the *Symphysis menti*.

Fig. 5. represents the bony part of the *Meatus auditorius* of the right ear; *a* the external orifice of the *Meatus auditorius*; *b* the *Processus petrosus*; *c* the orifice where the auditory nerve enters; *d* the *Meatus auditorius*; *e* a part of the *Laminæ*, which proceed from it on each side, and by which the cellules betwixt the two tables of the scull are formed, those situated above the *Meatus* being removed; *f* part of the inner table of the scull.

Fig. 6. represents part of the *Meatus auditorius* opened, with other parts of the inner ear; *a* the ragged part of the bone from which the *Os petrosum* was separated; *b* the *Processus petrosus* opened; *c* the *Crena* for the membrane of the *Tympanum*; *d* the honey-comb cavity of the *Tympanum*; *e* its inner cavity, of a smooth surface; *f* its semicircular, or undulated lines; *g* the orifice of the aqueduct; *h* the orifice of the *Portio dura* of the nerve.

Fig. 7. represents the lower surface of the *Os petrosum*, as it was separated from the upper part of the *Tympanum*, and other parts of the inner ear; *a a* the ragged margin of the bone; *b b* the upper part of the cavity of the *Tympanum*; *c* the *Foramen ovale*; *d* the protuberance, wherein the labyrinth and *Cochlea* are lodged; *e* the orifice of the *Portio dura* of the auditory nerve.

Fig. 8. represents the *Malleolus* alone in its true dimensions; 1 the protuberant head; 2 the semicircular *Sinus* between it and the margin; 3 the *Sinus*, which receives the head of the *Incus*; 4 the angle below the *Sinus*, for the head of the *Incus*; 5 the angle where the *Manubrium malleoli* begins; 6 the *Manubrium malleoli*.

Fig. 9. represents the *Incus*; 1 the head of the *Incus*; 2 the *Sinus*, or neck of the *Incus*; 3 two *Apophyses*; 4 a long protuberance with the *Sinus* for the *Os quadrangulare* at its extremity.

Fig. 10 11 12 represent the *Stapes*; 1 the small part of the *Stapes*, where it is articulated with the *Incus*, with a *Sinus* at its

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its extremity, being the other half of the cavity for the *Os quadrangulare*; 2 2 two small portions of the *Stapes*, where it is articulated with the basis.

Fig. 11. the basis of the *Stapes* separated.

Fig. 12. the whole *Stapes*.

Fig. 13. the *Malleolus* and *Incus* joined together, with their lower side turned up; 1 the *Malleolus*; 2 its articulation with the *Incus*; 3 the *Incus*; 4 the *Manubrium malleoli*; 5 a point of the *Incus*, formed by the other two productions; 6 the long protuberance of the *Incus*; 7 the *Sinus* in the extremity of its long production.

Fig. 14. the *Malleolus*, *Incus*, and *Stapes* articulated together; 1 the *Incus*; 2 the *Malleolus*; 3 the *Stapes*, where it shuts up the *Foramen ovale*.

Fig. 15. represents the upper part of the *Lineæ semilunares*, or that side which is towards the passage of the auditory nerve; *a* the five extremities cut off; *b* the *Linea semilunaris major*; *c* the *semilunaris media*; *d* the *semilunaris minor*, which is towards the cavity of the *Tympanum*; *e* the common canule to the *major* & *minor*; *f* the *Major*; *g* the *Media*; *h* the *Cochlea*.

Fig. 17. represents the *Cochlea*.

Fig. 18. the *Vestibulum*; *b* the third gyration, or turning; *c* the orifice; *d* the first gyration or turning opened; *e* the second turning; *g* the orifice at the top of the *Cochlea*.

Fig. 19. represents the seat of the brain enlarged, that the orifices for the blood-vessels and nerves may be the more obvious; *a a*, the inner table without its surrounding cellules; *b b* the anterior *Sinus*; *c c*, the *Os ethmoides*, with its eminencies, *Sulci* and *Foramina* for the olfactory nerve; *d* the *Crista galli*; *e e* the anterior eminencies; *f f* the orifice for the optic nerve; *g g* the hole called the *Foramen lacerum*, thro' which pass the *Nervi motorii pathetici opthalmici*, or first branch of the fifth and sixth pair; *h h* the second branch of the fifth pair; *i i* the third branch of the fifth pair; *k k* the hole for the artery of the *Dura mater*; *l l* the hole for the carotid artery; *m m* the hole for the auditory nerve; *n n* the hole for the jugular vein; *o* the hole for the spinal marrow; *p p* part of the two condyles; *q* the external hole for the spinal marrow; *r r* the two middle *Fossæ*; *s s* the *Processus petrosus*; *t t* the posterior *Fossa*, or seat of the *Cerebellum*; *u* the seat of the pituitary gland; *x* the *Crena*.

Fig. 20. represents the *Uterus*; *a a* part of the *Ligamenta lata Uteri*; *b* part of the *Vagina* cut off; *c* the beginning of the body of the *Uterus*; *d* divided into two portions, with an in-

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terſtice in the middle; *e e* ſeveral eminencies, repreſenting the external part of ſo many cellules; *f f* the *Cornua uteri*; *g* a looſe membrane wrapt up, that the *Ovaria* below may appear; *h* the *Ovarium* ſtripped of the looſe thick membrane, which fluctuates above it; *i* the *Ovarium* covered with the membrane.

Fig. 21. repreſents the *Proboſcis* cut tranſverſely; *a a* the two cavities of the *Proboſcis*; *b* the *Septum*, which divides the cavities; *c c* the tendinous interſection, which runs from the fore to the hinder part; *d d* the tendinous interſection which runs from the right to the left; *e e e e* the inſertion of the four muſcles, into the tendinous interſection, whereby the fibres of the one aſcend, and thoſe of the other deſcend obliquely.

Fig. 22. repreſents the diſſected *Proboſcis*; *a* the external part of the cartilage, which ſurrounds the cavity of the *Proboſcis*, as it ariſes from the hole in the fore-part of the ſcull; *b b* that pair of muſcles called the *Levatores proboſcidis*, raiſed from above the aforeſaid cartilages, with their inner ſurface turned up, that the divarications of the blood-veſſels therein may appear; *c c* the orifices of the veins diſperſed in theſe muſcles; *d d* the orifices of the arteries; *e e* their ſeveral branchings; *f* the deſcent ſtreight along, above the cavity of the *Proboſcis*; *g g* the oblique deſcent of the fibres of the *Erectores proboſcidis*; *h* the tendinous interſection running down the middle of the *Proboſcis*; *i i* the orifices of the cavities of the *Proboſcis*.

Fig. 23. repreſents the extremity of the *Proboſcis* cut off; *a* a protuberance ariſing from the fore-part of the extremity of the *Proboſcis*, and extended into a cavity in the back-part *b*, whereby the animal takes hold of any thing.

Plate IX. Fig. 1. repreſents one of the rudiments of the teeth, taken out of the large hole in the inner ſide of the lower jaw (as repreſented by *b* Pl. VIII. Fi. 3.) but much enlarged in proportion; *a* its upper part, which is hard, ſolid and white; *b* its middle part diſtinguiſhed by ſeveral furrows and ridges; *c* its lower part, which is hollow, and into which enter, both the blood-veſſels, that ſerve for its nouriſhment, and a branch of the nerve, called *Maxillaris inferior*, proceeding from the fifth pair.

Fig. 2. repreſents a portion of the *Cuticula*, wherein is ſhewn its inner ſurface, and uſual thickneſs; at its margin on the left hand, and lower part, are ſeveral white lines, which Mr. *Blair* takes to be the lineaments of ſo many blood-veſſels; the pyramids, from whence the hairs proceed, with the ſeveral *Favi* or depreſſions.

Fig. 3.

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Fig. 3. repreſents one of the ſcabs, adhering to the *Cuticula*, where they are thickeſt.

Fig. 4. the firſt *Vertebra* of the neck, with its upper part in profile, to ſhew the holes for the vertebral artery; *a a* two protuberances, which reach on each ſide to the ſcull; *b b* two cavities ſhortened, which receive the condyles of the ſcull; *c c* the two holes, whereby the vertebral artery proceeds from the ſcull, and perforates this *Vertebra*; *d d* two holes thro' which the artery paſſes out from this *Vertebra*; *e e* a *Crena* between the two aforeſaid holes, where the artery is lodged.

Fig. 5. the fore-part of the firſt *Vertebra* ſhewn at large; *a* the hole for the ſpinal marrow; *b* the hole for receiving the tooth of the following *Vertebra*; *c c* two cavities for receiving the condyles of the ſcull; *d d* two holes for the cervical artery; *e* the upper-part of the *Vertebra*; *f* its lower part; *g g* the tranſverſe proceſſes, whoſe protuberances at the extremities are repreſented by *a a*.

Fig. 6. the back-part of the firſt *Vertebra* ſhewn at large; *a* the hole for the ſpinal marrow; *b* the hole for the tooth of the following *Vertebra*; *c c* the cavities which receive the body of the following *Vertebra*; *d* the lower part of the *Vertebra*; *e e* the holes for the cervical artery; *f f* the two tranſverſe proceſſes.

Fig. 7. the fore part of the ſecond *Vertebra*; *a a* the forked extremities of the protuberance, which ariſes inſtead of the ſpinal proceſs; *b* a *Sinus* between them; *c* the hole for the ſpinal marrow; *d* the tooth, which is received by the firſt *Vertebra*; *e e* the two convex ſurfaces, which are received into the hinder cavities of the firſt *Vertebra*; *f f* the two holes for the cervical artery; *g g* two tranſverſe proceſſes; *h* the lower part of the *Vertebra*.

Fig. 8. the back part of the ſame *Vertebra*; *a a* the protuberances of the ſpinal proceſs; *b* the *Sinus* between them, enlarged on the ſide; *c* the hole for the ſpinal marrow; *d* the point of the tooth appearing from the other ſide; *e e* the holes for the cervical artery; *f* the concave body of the *Vertebra*, which receives the convex ſurface of the following *Vertebra*; *g g* the tranſverſe proceſſes; *h h* the two oblique proceſſes, which receive the oblique proceſſes of the following *Vertebra*.

Fig. 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, the five following *Vertebræ* are repreſented by A B, whereof A repreſents the fore-part, B the back-part; *a a*, &c. the hole for the ſpinal marrow; *b b*, &c. their convex bodies, which are received by the concave ſurfaces of the following; *c c*, &c. their concave bodies, which

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receive the convex surfaces of the former; *d d*, &c. the holes for the cervical artery; *e e*, &c. the oblique processes; *f f*, &c. the transverse processes; *g g*, &c. the spinal processes, which in the fore-part of the third and fourth *Vertebra*, Fig. 9, 11, scarcely appear, but in their back-part. Fig. 10, 12, appear a little, in 5, Fig. 13, 14, arise to one inch and a half, and in 6. Fig. 15, 16, to three inches; *h h*, in 6. and 7. Fig. 15, 16, 17, 18. are protuberances, which run back to guard the cervical artery, as it passes from between the bodies of the *Vertebræ*, and quits the perforation in their transverse processes; *i i* two *Sinus's* in the back-part of the seventh *Vertebra*, which with the like surfaces in the following form a cavity, into which the condyles of the first ribs are received.

Fig. 19. represents the *Scapula*; *a*, the head of the *Scapula*, whereby it is articulated with the *Humerus*; *b b*, the two protuberances on each side of its head; *c* the neck of the *Scapula*; *d* a *Sinus* between the *Processus coracoides*, and the neck of the *Scapula*; *e* the *Processus coracoides* of the *Scapula*; *f* the *Processus spinosus*; *g* the extremity of the *Processus spinosus*; *h* a protuberance running forwards from the *Processus spinosus*; *i* the fore-part of the upper edge of the *Scapula*; *l* a thick spongy *Epiphysis*, which (at the upper edge of the *Scapula*) was separated by boiling; *m* the angle at the back-part of the *Scapula*.

Fig. 20. represents the lower or fore-part of the seven *Vertebræ* of the neck; *a*, *b*, *c*, &c. the lower or fore-part of the bodies of all the *Vertebræ*; *h h*, the transverse processes, which run obliquely forwards; *i i*, the transverse processes of the sixth *Vertebra*, running both before and behind to guard the cervical artery; *k*, a *Sinus* in the body of the seventh *Vertebra*, for receiving a part of the first rib.

Fig. 21. represents the fore-part of the *Ossa innominata*; A the *Pelvis* four foot six inches in circumference; B the *Os sacrum*; C the upper part of the *Os pubis*; B C between the *Os sacrum* and the *Os pubis*, one foot six inches; D E from the right to the left of the *Pelvis*, one foot five inches; C F, from the upper to the lower part of the *Os ilium*, one foot; G H, between the two outer extremities of the *Ossa innominata*, three foot six inches; B H from the *Os sacrum* above to the aforesaid point, two foot nine inches and a half; from H to K, one foot; L the circumference of the *Acetabulum* one foot six inches; E H the breadth of the *Os ilium* one foot one inch; M M, the circumference of the neck of the *Ilium*, one foot two inches; N N the breadth of the *Os pubis*, eight inches; O O, the length of the *Foramen ovale* for the

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the *Musculus marsupialis*, five inches and a half; P P its breadth four inches; Q Q its circumference one foot one inch; R R the breadth of the *Os pubis* before, one foot five inches; S T the length of the *Os sacrum*, from where it is joined with the *Vertebræ* of the loins, to where it is joined with the tail.

Fig. 22. represents the back-part of the *Ossa innominata*; A the *Pelvis*; B the back-part of the *Os pubis* at their articulation, where there is a large cavity; C C, the oval hole for the *Musculus marsupialis* fore-shortened; D the cavity for the *Acetabulum*; E E the margin of the *Os ilium*, which was separated by boiling; F the back-part of the *Ossa innominata*, shewing the spinal, and oblique processes.

Plate X. Fig. 1. represents the back-part of the fore-foot; *a a* the bones of the *Carpus*; *b b* the bones of the *Metacarpus*; *c c* the *Ossa sesamoidea*, of which there are two upon the lower extremity of each bone of the *Metacarpus*; *d d* the bones of the toes.

Fig. 2. represents the back-part of the hinder-foot; *a* the *Talus*; *b* part of the *Astragalus*; *c c* bones of the *Tarsus*; *d d* bones of the *Metatarsus*; *e e* bones of the toes.

Fig. 3. represents the bones of the *Carpus* separately; 1. The upper surface of the external bone of the first phalanx of the *Carpus*; 2. the middle bone; 3. the third bone of the first phalanx; 5. 6. the upper surface of the three bones of the second phalanx.

Fig. 4. represents the bones of the *Tarsus* separately; 1. the upper surface of the *Astragalus*; 2. the upper surface of the *Os naviculare*, much enlarged in proportion to the rest; 3. its lower surface; 4. 5. 6. the upper surface of the *Ossa cuneiformia*.

Fig. 5. represents the concave side of the liver; *a* the *Vena porta*; *b* the *Vena cava*.

Fig. 6. 7. represents the *Os hyoides*; *a* the fore-part.

Fig. 7. *b* the back part; *d d* the *Cartilago scutiformis*; *e e* the lateral *Ossa hyoidea*; *f f* the bones of the base of the *Os hyoides*.

The Dissection *of the* Heart *of* Land Tortoises *from* America; *by M.* Bussiere. Phil. Trans. N° 328. p. 170.

THE heart in this animal is situated in the anterior part of the cavity, that forms the *Abdomen*, and separated from all the other *Viscera* by a large *Pericardium*, that incloses it; this *Pericardium* is fastened by its superior part to the spine of the back, and by the anterior part to the muscles of the neck, which is the cause that the heart moves forwards, when the animal

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mal puts forth his head out of the ſhell, and backwards, when he draws it in; by the inferior part it adheres to the *Peritonæum*, which is faſtened to the lower ſhell; ſo that by all theſe ligaments, the *Pericardium* being kept ſufficiently diſtended, the heart has an entire liberty therein; there was found in this *Pericardium* a conſiderable quantity of a very clear and tranſparent water, which has the ſame uſe there, as that found in the *Pericardium* of other animals; the heart is ſuſpended in the middle of this *Pericardium*; to wit, at its *Baſis* by the arteries, and at its inferior part by a ſmall tendon, or a very thin ligament; which, from the point or cone of the heart, aſcends to inſert itſelf into that part of the *Pericardium* which adheres to the back; this ſmall ligament is very remarkable in this, that by means thereof the point of the heart is ſuſpended on the level of its *Baſis*; without which, it is plain, that the point of the heart would fall lower, and bend the veſſels of the *Baſis*; which might interrupt the free circulation of the blood, and conſequently endanger the life of the animal: The *Pericardium* being opened, the heart appear'd, as if it were ſtanding by itſelf, being only fixed to the arteries which go out of it (ſuppoſing the animal turned on its back) its auricles being ſeparated, and hid under its *Baſis* and arteries, towards the back of the animal; which is very different from the ſea-tortoiſes, where the auricles are ſituated on the right and left angle of its *Baſis*, by which way they protrude the blood into the heart: The ſhape of the heart of this animal is almoſt lenticular; forming, nevertheleſs, three obtuſe angles, two on the *Baſis*, one to the right, and the other to the left, and the third at the inferior part, where the ſmall tendon, which ſuſpends the heart on the level of its *Baſis*, is inſerted; if this animal be opened alive, you may obſerve the circulation of the blood, becauſe of the tranſparency of the membranes of the veins, and the alternate motions, or dilatations of the heart and auricles, arteries and veins, which are very ſlow in this animal; from the *Baſis* of the heart paſs out four large arteries, that appear diſtinctly ſeparated from each other; whereas in that of the ſea-tortoiſe, theſe arteries are involved the length of an inch in a *Capſula* common to them all, which makes them appear as if they were but one trunk; if theſe four arteries be entirely cut, the heart is no longer ſuſpended, but by the conjunction of the two muſcular conduits of the auricles, which pierce the heart in its poſterior part towards its middle on the left ſide; by which the blood runs from the auricles into the ventricle of the heart: Theſe arteries

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arteries being thus divided, and the heart turn'd over, the auricles appear lying tranſverſely againſt the back, in the capacity of the *Pericardium*; they form but one continued fleſhy body, a little extended, and inclining about two inches to the left ſide; it is in this body, that the cavities of the auricles are ſeparated from each other by a muſcular *Septum*, ſituated internally at that part, that appears contracted externally; theſe auricles form a muſcular production about ſix lines in length, which unites them to the heart, towards the middle and left part of its back-ſide; this production conſiſts of two conduits, ſeparated from each other only by the extenſion of the *Septum*, which divides the two auricles; it is by theſe two conduits that the blood flows from the auricles into the heart; the body of theſe auricles has no adheſion to the *Pericardium*, nor any ſupport, but that of the veins, which terminate therein; for upon dividing theſe veins, the heart and auricles come out of the body; and then upon ſuſpending the heart by the auricles, they reſemble two funnels joined together, the ſmall extremity of which opens into the ventricle of the heart, to pour the blood into it; and it is in this manner we are to conceive them in the natural ſituation of the animal: In order to examine the inſide of the heart and its auricles, it muſt be opened at its inferior ſurface (ſuppoſing the animal turned on its back) becauſe all the orifices either of the arteries or veins, and their valves, are in the oppoſite ſide; therefore a probe may be introduced thro' one of the arteries into the heart, and opened upon it; after that you cut all this ſide round about the inferior circumference, from one angle to the other, and then turn over all that part, which is cut on the baſis of the heart; for then it is eaſy to view all the internal parts of the heart, and obſerve that there is but one only ventricle which compriſes the whole extent of the heart, and is as uniform, and plain, as either of the ventricles of the human heart, or of any other animal whatſoever; and that there is no manner of *Septum*, either muſcular or membranous obſervable, that might make any diviſion or cellule in this ventricle; ſo that it is ſurpriſing that the anatomiſts of the Royal Academy of *Paris* ſhould have ſhewn, the one three, the other four ventricles in the heart of a land-tortoiſe of *America*: After having conſidered the extent of the cavity of the heart, there remain two things to be examined, 1. That in its back-part there are five holes or orifices, two of which are on the left ſide; theſe are the orifices of the two funnels of the auricles; they are covered by a large valve, which lies flat thereon, and ſupported in its middle by the prolongation of the *Septum*, which divides

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divides the auricles in ſuch a manner, that half of it covers the orifice of the right auricle, and the other half that of the left; ſo that this valve reſembles two folding doors of a porch, which have the ſame ſupport, and whereof one opens or ſhuts to the right, and the other to the left; it is plain, that this valve permits the blood to enter into the ventricle of the heart, but oppoſes its return into the auricles; becauſe this blood being once in the heart, preſſes by its own weight upon this double valve, and keeps it cloſe and flat upon theſe orifices; and this perfectly well confirms the office of the valve, in the *Foramen ovale* in the heart of a human fœtus, the diſpoſition being entirely the ſame; the other three holes lying on the right ſide of the ventricle of the heart, are the orifices of the four arteries, which come out of the baſis; of theſe three holes, that moſt to the left, is the orifice of the pulmonary artery; the higheſt, the orifice of the *Aorta ſiniſtra deſcendens*; and that moſt to the right-ſide, is common to the *Aorta dextra*, and to the ſuperior *Aorta*; each of theſe orifices is furniſhed with two ſemi-lunar valves, which permit the blood to paſs without difficulty from the ventricle of the heart into the arteries, but hinder its return into the heart; all theſe holes are in one and the ſame cavity, ſo that the blood enters into this cavity only, by the two holes on the left ſide, and goes out of this ſame ventricle, by the three holes on the right ſide: The ſecond thing remarkable in this ventricle is, the fibres of the heart; they are of two ſorts; ſome are external, diſpoſed under the common membrane in ſeveral planes, very ſmall, but obliquely circular, extending from the baſis, but particularly about the arteries, which ſerve them inſtead of tendons, or points of ſupport, towards the inferior circumference of the heart; the other muſcular fibres, which compoſe the heart, are in the manner of ſeveral columns, as thoſe of the human heart; they are ſituated internally on both ſides, lying obliquely from the right, where their tendons are about the arteries, to the left; which ſhews that their action is from the left to the right ſide, where the orifices of the arteries lie open to let the blood paſs out: It has been ſaid above, that the two auricles of the heart of the land-tortoiſe of *America*, form externally but one continued body, which internally has two cavities, ſeparated from each other by a muſcular *Septum*, which ſeparates them ſo exactly, that there is not the leaſt communication between them; ſo that the blood of either auricle does not mix with that of the other, except in the ventricle of the heart; the right auricle is as big again as the left, all the blood of the animal (that of the lungs excepted) paſſing thro' it to go into the heart;

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heart; the left auricle receives only the blood, which comes from the lungs, the pulmonary veins being very ſmall; the internal part of the auricles are furniſhed with ſmall muſcular columns, but eſpecially at their extremities, and ſituated in ſuch a manner, that it is plain their action tends to puſh the blood againſt the *Septum*, where the conduits, which convey it into the heart, are ſituated: There is in the bottom of the right auricle an oblong orifice, whereby the blood comes into its cavity from the great reſervoir of the veins, ſituated on the back-part of the heart; this orifice is furniſhed with two ſemi-lunar oblong valves, diſpoſed in ſuch a manner, that when the auricle is relaxed, the blood enters its cavity; but when contracted, they ſhut cloſe to hinder the blood from returning into the veins; the orifice of the funnel, or conduit into the heart, is to be ſeen againſt the *Septum*; the left auricle has exactly the ſame ſtructure with the right; in the bottom of this auricle is to be obſerved the orifice, common to the two pulmonary veins, and furniſhed with two ſemi-lunar valves; and againſt the *Septum* to the right is ſituated the funnel or conduit into the heart, joining with the funnel of the right auricle; theſe two conduits are ſeparated from each other by the continuation of the *Septum*, which divides the auricles to the very ventricle of the heart, and ſerves for a ſupport to the middle of the double valve, which covers their orifices in the heart.

It has been ſaid above, that from the baſis of the heart of the land-tortoiſe of *America* there go out four large arteries; of which the firſt that preſents itſelf (the tortoiſe being turned on its back) is the pulmonary artery; it is more on the left ſide than the others, and much larger for the ſpace of an inch; then it divides itſelf into two branches, of which the moſt apparent comes from the right ſide of its trunk, and turns itſelf over towards the left-ſide, accompanying the *Aorta inferior ſiniſtra*, till it has pierced the *Pericardium*; after that it unites with the left branch of the *Trachea*, which it accompanies thro' all the extent of the left lobe of the lungs; the other pulmonary branch, going out of the left ſide of its trunk, turns itſelf over immediately croſs upon the other arteries, from the right to the left, to join the *Aorta inferior dextra*, till it has pierced the *Pericardium*; where it joins the right branch of the *Trachea*, which it accompanies thro' the whole extent of the right lobe of the lungs? One thing that ſeemed very remarkable to M. *Buſſiere* in this pulmonary artery, was, that tho' its trunk in going out of the heart exceeds more than twice the diameter of the *Aorta ſiniſtra*, yet neither of the two branches it ſends to the lungs, are $\frac{1}{3}$ of the diameter of the

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Aorta ſiniſtra; in the arteries, which M. *Buffiere* injected with wax, the trunk of the pulmonary artery was between ſeven and eight lines in diameter; the *Aorta ſiniſtra* four and a half, and neither of the pulmonary branches, after having pierced the *Pericardium*, exceeded a line and a half in diameter, tho' this artery does not emit any other branch; all the blood, which enters from the heart into its trunk, is conveyed into the two lobes of the lungs, and no where elſe; the reaſon of ſuch diſproportion M. *Buffiere* could not determine; but this is matter of fact, ſeeing it is the ſame in all; yet if he may be allowed to conjecture, he thinks it may be attributed to the alteration that happens to the branches of the *Trachea*, when the tortoiſe ſtretches forth its head out of the ſhell; for theſe pulmonary branches forming a ſemi-circle before they join the *Trachea*, when the animal's head is drawn in, the extenſion theſe branches of the *Trachea* underwent, when the animal goes out of the ſhell, turns theſe ſemi-circles into acute angles; inſomuch, that thereby the paſſage of the blood is ſomewhat interrupted; and conſequently the blood, which paſſes continually from the heart into the trunk, not being able to return back again, becauſe of its valves, muſt neceſſarily dilate this trunk more than the other arteries; and what convinced M. *Buffiere* that there does not go into the lungs of this animal a greater quantity of blood than what the pulmonary branches can admit by their ſmall diameter, and not that quantity which the diameter of their trunk could furniſh, was, that neither of the pulmonary veins, which return all the blood of the lungs into the left auricle of the heart, is quite two lines in diameter, which is very proportionable to the bigneſs of the two pulmonary branches of the arteries: The ſecond artery which goes out from the baſis of the heart, is what M. *Buffiere* calls the left *Aorta*; it aſcends as it comes out of the heart, together with the left pulmonary artery, till they have pierced the *Pericardium*; after which it forms a large turning, without any ſupport, towards the left ſide, which gives it liberty to extend, when the animal ſtretches itſelf out of its ſhell, and to refold itſelf up again, when it retires into it; after that this artery deſcends againſt the back, where it gives ſome ſmall branches to the ſpinal marrow; then it returns thro' the lungs into the *Abdomen*; and here it produces a conſiderable branch, which divides into two; one of which is diſtributed to the liver, the ſtomach and inteſtines; and the other turning towards the right in the middle of the *Abdomen*, unites with the right *Aorta*, ſo that theſe two arteries are but one and the ſame branch divided into two; the left *Aorta* is afterwards con-

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continued to the lower belly, to be distributed to the kidneys, thighs, and the inferior parts; this left *Aorta* is much longer than the right, because of the large circle it forms when it comes out of the heart, to accommodate itself to the motions of the animal, and to make room for its head, which is placed under this artery in the left side, when it draws it into its shell; and it is for that reason, that the left branch of the *Trachea* is longer than the right *Aorta*, because it furnishes a greater number of parts with blood; it has a distinct orifice into the ventricle of the heart, and not the least communication with the pulmonary arteries, neither in the heart, nor in any other part; and this does not at all resemble the *Ductus arteriosus* in the heart of a human *Fœtus*: The third artery, going out from the basis of the heart of this animal, is what M. *Busiere* calls the right descending *Aorta*; after having pierced the *Pericardium*, it sinks towards the back; then returning thro' the lungs into the *Abdomen*, where it receives the branch of the left *Aorta*, it is distributed to the right kidney, thighs, bladder, and parts of generation; so that M. *Busiere* calls these two arteries, the descending *Aorta*, because they distribute the blood to all the inferior parts of this animal; in the same manner as the descending *Aorta* does in all other animals: The fourth artery, going out from the heart, is the ascending *Aorta*; it has an orifice in the ventricle of the heart, common with the right descending *Aorta*; it partly appears under the left *Aorta* coming out of the heart, and ascends in a strait line till it has pierced the *Pericardium*; after which it divides into three principal branches, the two lateral of which tend to the fore-legs, and form the carotid artery; the third ascends all along the *Trachea* towards the *Larynx*, and gives branches to all the parts of the neck.

The disposition of the arteries, which go out of the heart, being examined, there only remain the veins, which convey the blood into it from all the parts of the animal; but first it is to be observed, that there are no veins which terminate in the heart; for all the veins open into the auricles, which are, as has been said, separated from the heart: There are two ways to shew these veins without dissection; the first is to inject them with wax, by syringing it into them by their orifices in the auricles; for if you inject by the oblong orifice in the right auricle, all the veins of the body (excepting those of the lungs) will be entirely filled; and afterwards by injecting into the oval orifice in the left auricle, the two veins of the lungs will be full at once, thro' the whole extent of the *Trachea* in the lungs: The other way is to wait till

the animal has expired; because the heart losing its vigour insensibly (it beating for the space of 24 hours) it has not then the force to discharge itself of the blood, which comes from all parts into these veins, which then grow very turgid by coagulated blood collected in them; then you need only turn over the heart towards the neck, and cut the coronary vein, which comes out of the substance of the heart, to observe all the large veins without dissection; because they all come and terminate in a common reservatory, situated across in the capacity of the *Pericardium*, joining to the auricles; and here one may observe a large vein, or an irregular reservatory; in tortoises 18 or 20 inches long, that M. *Bussiere* dissected, this reservatory was 10 inches broad, and 18 inches long; and in it the two axillary veins, from the upper parts of the body, join each other, after having pierced the *Pericardium* one on the right side, and the other on the left; from the inferior parts there join two large veins, one on the right side, and the other on the left of the inferior part of this reservatory; the first of which is formed of all the branches, which come from the right lobe of the liver, which is very large; and the other only consists of the veins of the left lobe of the liver, but also of a vein which supplies the place of the *Cava*, and which he calls *Vena intestinalis*; because after it has received all the veins of the inferior parts of the animal, it runs all along the intestines, from which it receives the veins; and being arrived at the *Pylorus*, it passes cross the left lobe of the liver, and terminates in the common reservatory: Besides these four large veins, there are three, and sometimes but two, issuing from the middle part of the liver, which are inserted into the bottom of the reservatory; as also the little coronary vein from the heart: All these veins being thus re-united in one common place, this reservatory terminates upwards in a tube, which is inserted into the posterior part of the right auricle, and opens into its cavity by an oblong orifice, furnished with two long semi-circular valves; which permit the blood of the reservatory to enter into the auricles, but hinder its returning from the auricles into the reservatory; a little above the reservatory, under the left auricle, are to be seen the two pulmonary veins; the left after having entered the *Pericardium*, is hid under the axillary vein, and does not separate itself therefrom, but a little above the auricles; from thence it bends to go, and insert itself into the posterior part of the auricles; after the same manner the right pulmonary vein follows the right axillary vein; which it quits after it has entered the *Pericardium*, to traverse almost all the length of the reservatory, and meet the left pulmonary

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monary about two lines distance from the auricles; these two veins thus united, open into the posterior part of the left auricle by a common oval orifice, furnished with two semilunar valves; by which means they pour into this auricle all the blood that comes from the lungs to the heart.

By all that has been observed concerning the structure of the heart of the land tortoise of *America*, and the disposition of both its auricles and vessels, how extraordinary soever it may appear, it is impossible to find out the least thing, that may affect the opinion of Dr. *Harvey*, and all other anatomists, about the manner of the circulation of the blood in the heart of a human *Fœtus*, and the use of the valve at the *Foramen ovale*; which is to permit the blood to pass from the right auricle thro' this hole into the left, and hinder the blood from passing from the left auricle by this hole into the right; and M. *Bussiere* adds farther, that amongst all animals we know, a person could not chuse one, whose heart may be more proper to confirm this opinion, than the land tortoise of *America*; by reason of the simplicity of its structure, and of the plain and distinct manner in which all the parts appear.

Plate X. Fig. 8. *a a a* represents the heart; *b b b* its auricles; *c* the trunk of the pulmonary artery; *d* the left descending *Aorta*; E the superior *Aorta*; H the right descending *Aorta*; F the ligament that suspends the cone of the heart in the *Pericardium*; G G G G G the *Pericardium* laid open.

Fig. 9. *a a a* represents the heart laid open, to shew the parts of its ventricles; *b* the double valve covering the orifices of the ducts from the auricles; *c* the orifice of the right auricle I; *d* that of the left H; *e* the orifice of the pulmonary artery K; *f* that of the left *Aorta* L; *g* the orifice common both to the right *Aorta* M, and the superior *Aorta* N.

Fig. 10. *a a a* represents the auricles; *b* the right auricle; *c* the left auricle; *d d* the muscular *Septum*, that divides the cavities of the auricles; E the orifice of the reservoir of the veins; F the orifice of the pulmonary veins; *g g* the large parts of the funnels; H the muscular duct of the funnels; I I the reservoir of the veins; K the left axillary vein; M the great intestinal vein; N the great hepatic vein; *o o* the two small hepatic veins; P the right pulmonary vein; *q* the left pulmonary vein.

Fig. 11. *a* the heart of the tortoise; *b* the trunk of the pulmonary artery; *c c c*, &c. the branches of the pulmonary artery, accompanying the *Bronchia* in the lungs; *d d d d* the left descend-

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ſounding *Aorta*; *e e e e* the right deſcending *Aorta*; *f f* a branch of the left *Aorta*, which communicates with the right *Aorta*; *g g* the inteſtinal artery; *b* the ſuperior or aſcending *Aorta*; *i* the ligament that ſuſpends the heart; K the *Trachea*; L L L L *&c.* the two branches of the *Trachea* tending to the lungs.

An Argument for Divine Providence, *taken from the conſtant regularity obſerved in the Births of both Sexes; by Dr.* Arbuthnot. Phil. Tranſ. N° 328. p. 186.

AMONG innumerable footſteps of divine providence to be found in the works of nature, there is a very remarkable one to be obſerved in the exact balance, maintained between the numbers of men and women; for by this means it is provided, that the ſpecies can never fail, nor periſh, ſince every male may have his female, and of a proportionable age; this equality of males and females is not the effect of chance, but of a divine providence, which the Dr. thus demonſtrates.

Let there be a die of two ſides, M and F (which denote croſs and pile) now to find all the chances of any determinate number of ſuch dice, let the binome M + F be raiſed to the power, whoſe exponent is the number of dice given; the coefficients of the terms will ſhew all the chances ſought; *e. g.* in two dice of two ſides M + F, the chances are $M^2 + 2MF + F^2$; that is, one chance for M double, one for F double, and two for M ſingle, and F ſingle; in four ſuch dice, there are chances $M^4 + 4M^3F + 6M^2F^2 + 4MF^3 + F^4$; that is one chance for M quadruple, one for F quadruple, four for triple M and ſingle F, ſix for double M and double F, four for ſingle M and triple F; and univerſally, if the number of dice be *n*, all their chances will be expreſſed in this ſeries.

$$M^n + \frac{n}{1} \times M^{n-1}F + \frac{n}{1} \times \frac{n-1}{2} \times M^{n-2}F^2 +$$

$$\frac{n}{1} \times \frac{n-1}{2} \times \frac{n-2}{3} \times M^{n-3}F^3 +, \&c.$$

It plainly appears, that when the number of dice is even, there are as many M's as F's in the middle term of this ſeries, and in all the other terms there are moſt M's or moſt F's; if therefore one undertake with an even number of dice to throw as many M's as F's, he has all the terms but the middle term againſt him; and his chance is to the ſum of all the chances, as the coefficient of the middle term is to the power of two, raiſed to an expo-

exponent equal to the number of dice; ſo in two dice his chance is $\frac{2}{4}$ or $\frac{1}{2}$; in three dice $\frac{6}{16}$, or $\frac{3}{8}$; in ſix dice $\frac{20}{64}$ or $\frac{5}{16}$; in 8 $\frac{70}{256}$, or $\frac{35}{128}$, &c. To find this middle term in any given power, or number of dice, continue the ſeries $\frac{n}{1} \times \frac{n-1}{2} \times \frac{n-2}{3}$, &c. till the number of terms be equal to $\frac{1}{2}n$; e. g. the coefficient of the middle term of the tenth power is $\frac{10}{1} \times \frac{9}{2} \times \frac{8}{3} \times \frac{7}{4} \times \frac{6}{5} = 252$; the tenth power of 2 is 1024; if therefore A undertake to throw with ten dice in one throw an equal number of M's and F's, he has 252 chances out of 1024 for him, that is his chance is $\frac{252}{1024}$, or $\frac{63}{256}$, which is leſs than $\frac{1}{4}$. It will be eaſy by the help of logarithms, to extend this calculation to a very great number: It is plain from what has been ſaid, that with a very great number of dice, A's chance would become very ſmall, and conſequently (ſuppoſing M to denote male and F female) that in the vaſt number of mortals, there would be but a ſmall part of all the poſſible chances, for its happening at any aſſignable time, that an equal number of males and females ſhould be born: It is indeed, to be confeſſed, that this equality of males and females is not mathematical but phyſical, which alters much the foregoing calculation; for in this caſe the middle term will not exactly give A's chances, but his chances will take in ſome of the terms next the middle one, and lean to one ſide or the other: But it is very improbable (if mere chance governed) that they would never reach as far as the extremities; but this event is prevented by the wiſe oeconomy of nature; and to judge of the wiſdom of the contrivance, we muſt obſerve, that the external accidents to which males are ſubject (who muſt ſeek their food with danger) make a great havock of them, and that this loſs far exceeds that of the other ſex, occaſioned by diſeaſes incident thereto, as experience convinces us: To repair that loſs, provident nature, by the diſpoſal of its wiſe Creator, brings forth more males than females, and that in almoſt a conſtant proportion; this appears from the annexed tables, which contain obſervations for 82 years of the births in

London: Now to reduce the whole to a calculation, the Dr. propoſes this problem.

A lays againſt B, that there ſhall be born every year more males than females; to find A's chance, or the value of his expectancy.

It is evident from what has been ſaid, that A's chance for each year is leſs than half; but that the argument may be the ſtronger, let his chance be equal to half for one year; if he undertake to do the ſame thing 82 times running, his chance will be $\frac{1}{2}$] 82, which will be eaſily found by the table of logarithms to be $\frac{1}{4836,0000,0000,0000,0000,0000}$; but if A wager with B, not only that the number of males ſhall exceed that of females every year, but that this exceſs ſhall happen in a conſtant ratio, and the difference lie within fixed limits; and this not only for 82 years, but for ages of ages; and not only at *London*, but all over the world (which it is highly probable, is matter of fact, and deſigned that every male may have a female of the ſame country and ſuitable age) then A's chance will be near an infinitely ſmall quantity, at leaſt leſs than any aſſignable fraction; from whence it follows, that it is *art*, and not *chance* that governs: There ſeems no more probable cauſe to be aſſigned in phyſics for this equality of the births, than that in our firſt parents ſeed there were at firſt formed an equal number of both ſexes.

Scholium, From hence it follows, that polygamy is contrary to the law of nature, and juſtice, and to the propagation of the human race; for where males and females are in equal numbers, if one man take 20 wives, 19 muſt live in celibacy, which is repugnant to the deſign of nature; nor is it probable that 20 women will be ſo well impregnated by one man, as by 20.

Anno	Chriſtened Males	Females	Anno	Chriſtened Males	Females
1629	5218	4683	1638	5359	4952
30	4858	4457	39	5366	4784
31	4422	4102	40	5518	5332
32	4994	4590	41	5470	5200
33	5158	4839	42	5460	4910
34	5035	4820	43	4793	4617
35	5106	4928	44	4107	3997
36	4917	4605	45	4047	3919
37	4703	4457	46	3768	3395

Anno

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Anno	Christened Males	Females	Anno	Christened Males	Females
1647	3796	3536	1679	6247	6041
48	3363	3181	80	6548	6299
49	3079	2746	81	6822	6533
50	2890	2722	82	6909	6744
51	3231	2840	83	7577	7158
52	3220	2908	84	7575	7127
53	3196	2959	85	7484	7246
54	3441	3179	86	7575	7119
55	3655	3349	87	7737	7214
56	3668	3382	88	7487	7101
57	3396	3289	89	7604	7167
58	3157	3013	90	7909	7302
59	3209	2781	91	7662	7392
60	3724	3247	92	7602	7316
61	4748	4107	93	7676	7483
62	5216	4803	94	6985	6647
63	5411	4881	95	7263	6713
64	6041	5681	96	7632	7229
65	5114	4358	97	8062	7767
66	4678	4319	98	8426	7626
67	5616	5322	99	7911	7452
68	6073	5560	00	7578	7061
69	6506	5829	01	8102	7514
70	6278	5719	02	8031	7656
71	6449	6061	03	7765	7683
72	6443	6120	04	6113	5738
73	6073	5822	05	8366	7779
74	6113	5738	06	7952	7417
75	6058	5717	07	8379	7687
76	6552	5847	08	8239	7623
77	6423	6203	09	7840	7380
78	6568	6033	10	7640	7288

Experiments concerning the time required in the Descent of different Bodies of different Magnitudes and Weights in common Air, *from a given Height; by Mr.* Francis Hauksbee. Phil. Trans. N° 328. p. 196.

IN order to make these experiments accurately, Mr. *Hauksbee* devised the following *Apparatus*; at the height from which the balls were to be dropped, he fixed a contrivance in form of a trough, in all about four foot long; and the end of it, on which the balls were laid, was loose, swinging on two pins at the extremity thereof; this loose end was supported by a thin piece of board, which slid under it thro' a groove from the other part of the board; to this sliding board there was

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fixed a ſtring, which was tied to a ſmall wire that reached to the bottom of the deſcent, where the wire had a communication with a contrivance, to give motion to a *Pendulum* that vibrated half ſeconds; now, when this ſliding board was drawn from under that part of the trough, on which the balls were placed, the ſtring became thereby ſo much ſhorten'd, as to move the limb of that contrivance at bottom, which dropped the *Pendulum* at the ſame inſtant of time, as the balls began to deſcend.

Experim. 1. The firſt experiment he made was with two balls; one of them a thin glaſs-bubble, filled with mercury; its diameter was eight tenths of an inch, and its weight 840 grains; the other ball was of cork, whoſe diameter was two inches two tenths, and its weight 120 grains; when theſe balls were dropp'd, the *Pendulum* made eight vibrations, juſt as the ball with the mercury ſtruck the ground, and eight more were repeated before the cork arriv'd at the ſame place.

Experim. 2. He took a ball filled with mercury, much of the ſame weight and diameter as the former; the other was a thin glaſs bubble, its weight was 493 grains, its diameter four inches three tenths; when theſe came to deſcend, the *Pendulum* made juſt as many vibrations as in the laſt experiment; that is, the ball with the mercury ſtruck the ground at eight vibrations, and the other juſt at the end of 16 vibrations of the *Pendulum*.

Experim. 3. The ball with mercury that Mr. *Hauksbee* made uſe of in this experiment was likewiſe much of the ſame weight and diameter as before; the other ball was of glaſs, whoſe weight was 535 grains; its diameter one way meaſured five inches and a quarter, and its oppoſite diameter but five inches; upon the deſcent of theſe balls, the *Pendulum* made but one vibration more than in the other experiment; that is, the ball with mercury came to the ground exactly at eight vibrations, and there were nine more before the other ball arrived at the ſame place: Theſe experiments were made from the top of the *Cupulo* of St. *Paul's Church, London*; from whence to the floor, on which the balls were dropped, were meaſured near 220 feet; it is to be obſerved, that the balls with mercury made no ſenſible impreſſion on the floor on which they fell (which at that time was covered with deal boards) notwithſtanding their weight and velocity of deſcent.

The following experiments of the deſcent of bodies in air, were made in the ſame manner, at the place above-mentioned, anſwering very exactly with the former.

Mer-

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Mercury balls.			Large thin glass-balls.		
Weight in Grains.	Diam. in 10th's of inches.	Time of falling in half seconds.	Wt. in Grains.	Diam. inches 10th's	Time of fall. in half sec.
908	.8	8	510	5 . 1	17
993	.8	8 a little less	642	5 . 2	16
866	.8	8	599	5 . 1	16
747	.7½	8 a little more	515	5 . 0	16½
808	.7½	8	483	5 . 0	17
784	.7½	8 a little more	641	5 . 2	16

These experiments were made on the 9th of *June* 1710, at which time the height of the mercury in the barometer was 29. 7. inches, and the thermometer 60 degrees above the freezing point; and the mercury balls and the large thin glass balls were dropped together, as they are ranged in their several lines.

Experiments shewing the effects of air passed through red-hot metals, &c. by the same. Phil. Trans. N°. 328, p. 199.

IN order to find what effect such a *Medium*, as air, passed thro' red-hot metals, might have on the lives of animals, Mr. *Hauksbee* contrived the following method; he took a large receiver open at top, about four inches in diameter, which was covered with a brass-plate, and wet leather, as usual in glasses of such a make; to this plate at top (which had a screw with a small perforation) belonged a cock, and from that cock proceeded a small hollow wire, about three foot long; that end of the hollow wire, which was remote from the receiver, was put into a hollow piece of cast brass, pretty thick in substance, but the hole was not quite thro'; and the hole being larger than the small hollow wire, it was wedged into the same with pieces of steel wire, till the cast piece of brass was filled as full as it could hold; in this manner it was put into a charcoal fire, and there it lay till it was throughly red-hot; the receiver being then exhausted of its air, the cock on its upper part was turned, which gave liberty for that air only, which must necessarily pass thro' the red-hot metals, to succeed; this air first passing down thro' the small ducts between the red-hot wires, before it could come to enter the red-hot hollow brass wire, must necessarily suffer, or undergo such a change, as fire or the fumes of such red-hot metals would give it; when the receiver was filled with this air, and had stood some little time, the brass cover was

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taken off, and a pretty large cat immediately plunged into it, the cover being laid on again, the cat fell immediately into convulsions, and in less than a minute appeared without any sign of life; then taken out of the receiver, and laid on the floor, she remained as dead; but in less than a minute she began to discover life by a motion in her eyes, and after two or three hideous squalls, she began to recover apace, but was very fierce, and would spit and fly (as well as her weakness would suffer her) at any one that offered to touch her; but in half an hour after, or thereabouts, as her strength and ease recovered, so her former temper increased upon her, suffering herself to be handled without any signs of fierceness: The effect the same sort of factitious air had on flame, was as follows: Mr. *Hauksbee* no sooner came to plunge a lighted candle into it, but it was immediately extinguished; and this he observed several times, that when the candle was slowly immersed, so much of the wick (which before was lighted) as came but within the verge of the glass, died, and so the rest successively, as it descended to the same place; and this, upon several repetitions, answer'd much the same; but at some times, as the common air came to mix with it, one might plunge the lighted candle lower and lower, before it went out, till at last it would remain burning at bottom: As to the elasticity and specifick gravity of the above-mentioned medium, Mr. *Hauksbee* made several very accurate trials, but found it no ways differing from common air, in respect to those properties; hence it follows, that the foregoing effect is no ways assisted from any imperfection, or defect in the last-mentioned properties; therefore, the following queries seem to offer themselves. 1. Whether air itself may so suffer in its own nature, by any sort of fire, as to be divested of the power of subsisting life or flame; or, 2. Whether the *Effluvia*, or steams, proceeding from the red-hot metals, which the air may take along with it in its passage near them, do not very much contribute, if not entirely occasion the effect: If the latter takes place, Mr. *Hauksbee* supposes it may in some measure be applied to account for the effect, that the damps, or steams, which arise from subterraneous caverns, impregnated with metalline *Effluvia*, have on the lives of animals; and yet at the same time, the same air may suffer no change in respect to its other properties; *viz.* its elasticity and specific gravity, in comparison with other air in the same region.

To

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To ſhew the effect of air, that paſſed thro' a degree of heat, equal to that of boiling water, Mr. *Hauksbee* contrived a braſs-box, about four inches long, and an inch and a half over; at one extremity, which he ſoldered up, he fixed two ſmall braſs tubes; one of which went thro', and reached the remoter extremity nearly; the other tube was but juſt inſerted into it, but each of them long enough to reach above the ſurface of the water, wherein they were to be immerſed; theſe tubes were to convey the air into an exhauſted receiver; it firſt paſſed into that tube, which nearly reached its oppoſite extremity, and ſo into the other which led to the exhauſted receiver; but the box, with that part of the tube that was within it, was firſt heaped full of braſs-duſt, by means of a braſs-cap, which ſcrewed on to the extremity, not before mentioned; this braſs-duſt Mr. *Hauksbee* moiſtened with a little water, imagining thereby to make it exert a more than ordinary ſteam, or *Effluvium* from the metal, which the air might take along with it, as it paſſed thro' ſuch ſtrait and narrow avenues, as it muſt do between the braſs-duſt; in this manner it was immerſed in the water when cold, and continued in it, till it had boiled a conſiderable time; by which means it muſt, in all its parts, be of the ſame degree of heat (at leaſt) as the boiling water; thus it was taken out, and applied to the exhauſted receiver; where, upon turning a cock, he gave liberty for that air only to paſs into it, which muſt ſucceed thro' the braſs-box and duſt, under the circumſtances above-mentioned; when the receiver was full of this air, the cover was taken off, and a lighted candle plunged into it, where it continued burning, even at the bottom, as if it had paſſed through no ſuch medium, but had been full of common air; Mr. *Hauksbee* took that method to try it, ſuppoſing the flame of a candle to be the moſt tender way of diſcovering a change in air; afterwards he repeated the ſame experiment, with dry braſs-duſt inſtead of the former, but the ſucceſs was the ſame; therefore it ſeemed to him, that ſuch a degree of heat, as that of boiling water, is not ſufficient to cauſe any conſiderable change, if any change at all, in the air; nor that ſuch a degree of heat can ſtrike any noxious, or ſuffocating *Effluvia* out of the metallic particles.

The paſſing of air thro' a red-hot glaſs-tube into an exhauſted receiver, had no manner of influence on a ſparrow put into it; but upon paſſing of air thro' red-hot charcoal, before it entered the tube, that conveyed it into the exhauſted receiver;

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receiver; in that medium, the above-mentioned animal, in about a quarter of a minute, gave ſigns of expiring directly; but being taken out, it recovered at the ſame time, and continued living and well for ſome days after; yet it was concluded, had the bird's continuance in the receiver been but double that time, her recovery would have been very doubtful: Mr. *Hauksbee* likewiſe tried air paſſed thro' the flames of ſpirits of wine, and oil of turpentine; the effect was much the ſame as to the ſpirits of wine, the flame of a candle being immediately extinguiſhed upon its being plunged therein; but the air, which paſſed thro' the flame of the oil of turpentine, took ſome unctuous fumes along with it into the exhauſted receiver; which fumes, upon the near approach of a lighted candle, ſuddenly took fire, and continued to burn on the upper ſurface, till they were ſtifled by covering cloſe the receiver; and upon ſeveral repetitions it anſwered much the ſame, till the whole quantity of fumes was conſumed.

A Deſcription of the Apparatus *for making Experiments on the Refractions of Fluids; with a Table of the ſpecifick Gravities, Angles of Obſervation, and* Ratio *of Refractions of ſeveral Fluids, by the ſame.* Phil. Tranſ. N°. 328. p. 204.

THE whole *Apparatus* is fixed on a table parallel to its ſurface; on one and the ſame *Axis* is fixed a ſextant, of a *Radius* of four feet, and a moving limb to bear the object; the ſextant is divided into degrees and minutes by a diagonal, and remains always fixed; the object, which is placed on the moving limb, is ſeen parallel with the table, when obſerved thro' the priſm, and at no degrees on the ſextant; but when any tranſparent liquid is put into the ſame, the object muſt be elevated, till it appear to the eye; then obſerving how many degrees and minutes the *Index* on the limb cuts on the ſextant, we note it, and call it the angle of obſervation; thus for different liquids you have different elevations of the object, as you will find by the following table; the ſight is compoſed of two pieces of box-wood, planed parallel to each other; theſe pieces are ſeparated only by three ſlender ſlips of common cards, and ſo ſcrew'd down upon each other, exactly parallel with the *Axis* of the moving limb and ſextant; the priſm, thro' which it directs the ſight, is placed pretty near it, and conſiſts of an angle of 44 d. 54 m. which angle is fixed perpendicular to the plane of the table, its upper ſide being parallel to the ſame; the object is a piece of white

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white paper, in the form of a croſs, paſted on a black board, and fixed at the extremity of the moving limb, which is about ſeven foot long from the ſight; its diameter is about two inches and a half, which juſt comprehends the ſight thro' the ſlit; ſo that when the object is entirely within view, we conclude the obſervation to be exact; with this *Apparatus* the experiments are made as well by candle-light, as by day-light (the preſence of the ſun-beams being no ways neceſſary) and Mr. *Hauksbee* thinks they may be depended on as pretty accurate; he took the ſpecific gravity of the ſeveral liquids, where he could obtain a ſufficient quantity, as appears by the table; ſo that if any perſon ſhould have the curioſity to repeat theſe experiments, he muſt expect a different angle of obſervation, if the ſpecifick gravity do not agree with the table; for ſometimes it happens, that liquids of the ſame denomination are not always of an equal goodneſs, and conſequently will have a different ſpecific gravity and refraction.

Mr. *Hauksbee* preſſed the chryſtalline humour of an ox's eye into the angle of the priſm; whereby it received the form thereof, and gave the angle of obſervation, as ſpecified in the table; he could not ſee the common object thro' it, but was obliged to make uſe of a candle for that purpoſe; the flame of which appeared very broad, at leaſt five or ſix inches, nearly in the form of a half moon; but what ſhould occaſion ſuch a change of figure, Mr. *Hauksbee* could not then determine: Of all the fluids he tried, he found none to refract a ray of light leſs than water; yet there are ſeveral other liquids that form the ſame angle; he obſerved the oil of bees-wax to be the lighteſt fluid, and butter of antimony *per deliquium* to be much the heavieſt; the difference of ſpecific gravity between theſe two bodies, is as 662 to 1676, that is, nearly as 1 to 3; and the *Ratio* of their refractions only as 10000 to 6885 bees-wax, ſo is 5941 antimony to the ſame *Radius*, that is, as 1 is to 1.16, or thereabouts; likewiſe oil of vitriol is in ſpecifick gravity to oil of ſaſafras as 1510 is to 898; yet the *Ratio* of refraction of the lighteſt is moſt conſiderable, being in proportion, as 10000 is to 6475 ſaſafras, ſo is the ſame radius to 7011 vitriol; thus Mr. *Hauksbee* found, that a body does not refract in proportion to its ſpecific gravity, but from ſome quality peculiar to itſelf; whether it be from its inflammability, or from any different texture, or figure of its component parts, or whatever elſe it be, he leaves others to determine, as alſo the application of theſe following experiments.

Specific

Specific gravities in comparison with a bulk of water equal to 820 grains.		Angle of observation d. ′		Ratio of refraction as 10000 is to
		16	50	7485. 3
Oil of saſafras	898	29	20	6475. 8
Turpentine	713.5	25	25	6741. 8
Bees-wax	662	23	30	6885. 4
Caraways	752	26	13	6696. 5
Oranges	711	25	20	6741. 2
Hyſop	769.5	25	10	6757. 6
Roſemary	747	24	40	6794. 7
Savin	789	25	30	6730. 9
Origanum	752	25	00	6770. 2
Penny-royal	783	25	30	6730. 9
Mint	780.5	26	00	6706. 4
Spike	749	24	30	6807. 3
Fennel	798	27	10	6616. 5
Juniper	729	25	10	6757. 6
Cummin	766.5	27	00	6627. 7
Tanſey	757	23	46	6865. 1
Dill	795.5	27	40	6582. 7
Oil of amber	783	26	30	6662. 3
— Cinnamon	828	28	40	6517. 7
— Cloves	827	27	20	6606. 8
— Nutmegs	759	25	40	6721. 4
Spirits of wine	703.5	18	50	7287. 9
——— Hartſhorn	786	17	00	7468. 3
——— Vinegar	824.5	17	00	As hartſhorn
——— Sal. Armon.	794.5	16	56	7475. 2
Acids, ſpirit of amber	825	16	56	As ſal armon.
Oil of vitriol	1510	21	56	7011. 5
Spirit of nitre	1166	20	50	7104.
Aqua regia	987	19	50	7195.
Aqua fortis	1157	20	40	7120. 5
Aqua regia, from Aqua fortis and Sal armoniac	1034	20	10	7161. 5
Butter of Antimony	1976	40	00	5941. 3
Spirit of raw-ſilk	916	20	30	7135.
Spirit of honey	716	16	50	As water

Specific

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Specific gravities in comparison with a bulk of water equal to 820 grains.		Angle of observation. d.	'	Ratio of refraction as 10000 is to
Tinct. of Antimony	693	18	46	7294. 3
Jesuits bark	720	18	46	As tinct. of ant.
Salt. Tolu	717	19	34	7219. 3
Tinct. gum armoniac.	719	19	10	7257. 3
Metals	713	18	54	7281. 7
Vitreous humour of an ox's eye.		16	50	As water
Crystalline humour of an ox's eye.		24	10	6832. 7
White of a hen's egg		17	40	7401. 3
Jelly of hartshorn		17	50	7384. 7
Human saliva		16	50	As water
Human urine		17	05	7451. 9
French brandy.		18	20	7338. 6

Oil of turpentine strongly tinged green with filings of brass no ways alters its refraction.

A Demonstration of the Number of Acres *contained in* England, *and the Use that may be made of it; by Dr.* Grew. Phil. Trans. N° 330. p. 266.

SEveral persons, and some of great abilities, have given us, as they have supposed, the exact number of acres, contained in *England*, or *South Britain*, or very near it: Sir *William Petty* reckons about 28 millions, others 29 millions, and others again a few more; but the Dr. thinks they have all been mistaken in under-reckoning; and the reason of their mistake seems to have been their reckoning only by the maps; that is, by computed, and not by measured miles; by which last only the number of acres can be known: The Dr. had seen an account of the number of acres in each county; but whether taken from the Doomsday-book, or from any other registry, he affirms cannot be true; for tho' we have lost some land, yet there is a great deal more now gained, which in the conqueror's time lay under sea; within 120 years, much has been recovered from the sea, and maintained by banks

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in the marſhes and fens of *Eſſex*, *Kent* and the iſle of *Ely*; and in ſome parts of *Lincolnſhire*, the land has gained of the ſea, four miles in a direct line from land to ſea: Nor is the account the truer, for having been taken from any other record; for if the number of acres, according to the ſaid account, in each county, be put together, they do not exceed 39 millions and a quarter; which number tho' it come much nearer the truth than any of the former, yet is a great deal ſhort of it; for however, according to vulgar computation *England* be reckoned but 305 miles in length, and about 290 miles in breadth, nevertheleſs it appears by an exact wheel-meaſure, that from *New-haven* in the ſouth of *England* to *London* are 56 meaſured miles; and from thence in a ſtrait line continued to *Berwick* in the north, 339 of the ſame meaſured miles; in all 395, the true length of *England*; and again, that from the ſouth *Foreland* in the eaſt, to the *Lands-end* in *Cornwal*, are about 367 miles of the ſame wheel-meaſure, the true breadth of *England*. This being known, it is eaſy without any laborious, and coſtly ſurvey, to know alſo how many ſquare miles, and conſequently, how many acres are contained in *England*, and that in the following manner:

If a line be drawn on a chart of *England*, Plate X. Fig. 11. from the ſouth *Foreland* in *Kent* to *Berwick*, and if from the two extremities of this line, two more lines be drawn, meeting at the *Lands-end* in *Cornwal*, they will form the triangle A B C; which triangle, in that it excludes as much more of the land, as it includes of the ſea, as may anſwer the ſmall number of miles, obtained by the curvity of the roads, may therefore be allowed to be equal to the area of *England*; next, if to the triangle A B C another ſimilar and equal triangle B C D be added, both together form the rhomboid A B D E; which being divided at E F, forms the rhomboids A C E F and B D E F, equal to each other; one of which is therefore equal to the triangle A B C; and the rectangle A G H F, ſtanding upon the ſame baſe, and between the ſame parallel lines, with the rhomboid A C E F, by the 35. 1. of *Euclid*, is equal to the ſaid A C E F, equal to the triangle A B C, equal to the area of *England*: Now, the length between *Berwick*, and the ſouth *Foreland* in *Kent*, being about five miles more than between *Berwick* and *New-haven*, which is 395 miles; therefore the line A B may be taken for 400 miles, and ſo the line A F for 200; and the line A G being leſs by about ſeven miles than between the ſouth *Foreland* in *Kent*, and the *Lands-end* in *Cornwal*, which is 367 miles, the ſaid line A G, may be taken for 360 miles; therefore A G, 360, multiplied by A F 200, produces

72000

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72000 ſquare miles; and 72000 multiplied by 640, the number of acres contained in a ſquare mile, produces 46,080,000, the number of acres contained in *England*; whence it appears,

1. That if the province of *Holland* contain, as is computed, but 1,000,000 of acres, then *England* is more than 46 times as big as *Holland*, by a fraction of 80000 acres; next, if in the province of *Holland*, containing but 1,000,000 of acres, there are 2,00,4000 ſouls, or 2,000,000 and $\frac{4}{10}$, as they are computed to be; then *England*, which contains 46,000,000 of acres, to be proportionably populous, ſhould have twice 46,000,000 of people and $\frac{4}{10}$ of 46,000,000, that is, about 110,000,000: But to allow room enough for perſons of all degrees under our *Britiſh* monarchy, if *England* were half as populous as *Holland* with only 55,000,000, it were a good proportion, and would be near five times our preſent number, and about 22 times as many as in the province of *Holland*.

To people *England*, in a competent time with this number, there are ſundry ways very practicable; whereby the Dr. has computed, that the preſent number might be doubled in 24 or 25 years, and probably quadrupled in about 36 years: One of theſe ways, tho' not the ſpeedieſt, would be the introducing of ſtrangers; yet to make uſe of this, or of any other expedient, to multiply the people, before we had provided the means of employing them, would be prepoſterous: But when we ſhall once in good earneſt, mind our true intereſt in employing and encouraging every where our own hands, and the hands of other nations; as the *French* and *Dutch* do, in all ſorts of husbandry, manufactury and merchantry; when our nobility and gentry themſelves ſhall, as in ſome other countries, be examples in ſome or other of theſe particulars; when we ſhall hereby be univerſally engaged to incloſe, and improve every foot of our land, to make the utmoſt uſe of all our home growths, both above and under ground, and of all our ports (which are about 200 great and ſmall) more than in all the kingdoms and ſtates of *Europe* put together; and when both *Scotland* and *Ireland* ſhall afterwards be improved in like manner; when all mens heads and hands ſhall be thus employed about ſome one honeſt and profitable buſineſs, as it will naturally promote peace and friendſhip every where among us, ſo it is eaſy for any conſidering man to foreſee, how highly it will advance the *Britiſh* monarchy and people, both at home and abroad, in beauty, ſtrength and glory.

Observations on Spots *in the* Sun, *from* 1703 *to* 1711; *by Mr.* Derham, *with Mr.* Crabtrie's *Opinion of the ſolar Spots.* Phil. Tranſ. N° 330. p. 270.

FEW of the appearances in the following table eſcaped Mr. *Derham*'s ſight, he having been provided with competently good inſtruments to obſerve their places on the ſun; *viz.* a micrometer (after Mr. *Gaſcoigne*'s manner) to take their diſtance from the ſun's northern or ſouthern limb, which is parallel with the pole of the earth; and a half ſecond movement, to meaſure their diſtance from the ſun's caſtern, or weſtern limb.

A Table of the Spots *and* Faculæ *on the* Sun, *viſible at* Upminſter, *ſince* July 1703.

1703.		*Jan.* 23, none			30	*Feb.*	14	*Nov.*	1
Oct.	9	ſome	24		2		15		4
	10	vaniſhed	25		3		16		8
	11	*July*	18		7		18		10
Nov.	19		20		8		24	*N.B.* this	15
	22		21	*July*	24	*March*	6	*Nov.* 15.	16
			* 23		25		9	another	17
		Sep.	* 10	*Sep.*	4		11	ſpot ariſe	18
1704.		nothing	14				12	on the eaſ-	19
Jan.	16		18		5		14	tern ſide	20
	17		* 21		6		18	of the disk	22
	18	*Nov.*	17		7		21	whilſt this	
	19		18		8	*June*	* 29	was on the	
	21		21		10	extinct.	30	weſtern.	
	22	*Dec.*	* 2	faint	11	*July*	1		
	23			extinct	12	languid	2		
Jan.	30			*Oct.*	* 29	ſcarce } viſible }	4		
Feb.	23	1705.		*Nov.*	5	more } viſible }	5		
	25			faint	6	extinct	6		
March	7	*Jan.*	1		* 8	appears	8		
	8		2		28		* 10		
	9		3		29	*Aug.*	* 31		
	10		5		30	*Sep.*	* 12		
	11		* 25	*Dec.*	1		16		
	13	*Feb.*	* 19		2	Spot and	* 17		
April	11	*March*	14		3		19		
	12		16		4		21		
	13	*April*	1		5		27		
May	1	*May*	5		* 22	no ſpot or	* 28		
	11		6		* 31	*Oct.*	31		
			7	1707.					
			8						
			* 10						
			* 22						
			* 23						
		June	22						
			23						
			24						
			26						
			27						
			28						
			30						
		July	* 1						
			* 3						
			24						
		Sep.	30						
		Oct.	2						
			3						
			5						
			6						
			7						
			25						
			26						
			30						
			31						
		Nov.	2						
			4						
			* 21						
		1706.							
		Feb.	7						
		March	7						
			27						

In

In this table the *Faculæ* are marked with an asterisk; and the duration of every appearance of the same spots, or *Faculæ*, or the time they disappeared, are marked with a line: But here Mr. *Derham* selects some of the most remarkable observations; and first as to the figure of the spots; they are well known to change frequently; and therefore he thought it needless to give their figures every time he observed; but it is somewhat remarkable, that the spots generally appear longish near the extreme parts of the disk, for if they are never so round near the middle of the disk, they become longer and longer towards the extreme parts, till at going off, they seem to be nearly a strait line, and nearly parallel to the sun's limb; which is a manifest argument, that the sun is a globe, and that these spots are on, or very near its surface: Another thing remarkable is the mutability of the shape of the spots; Mr. *Derham* more than once plainly perceived them to change at the very time he had been looking on them; thus *November* 19, 1703 he saw three or more spots not far off the middle of the disk; and whilst he was viewing them, they seemed to vary, both as to their shape and strength; sometimes seeming stronger, sometimes shorter, sometimes spiss, and sometimes languid; and this they seemed to do, not only thro' his 16 foot telescope, (which Mr. *Derham* thought at first might be owing to the different disposition of his eye) but also when he received on a white paper in a darkened room the sun's image thro' a six foot telescope; the weather hindered Mr. *Derham* from seeing these mutable spots again, till *November* 22d following; and then they were become only like a thin smoke, or *Nebula*; so again *April* 11th 1704, there were divers spots with *Umbræ* about them; these *Umbræ*, or *Nebulæ* he could plainly perceive, whilst he was looking on them, to be sometimes very faint and thin, and at other times much darker and thicker; he observed that these *Maculæ* and *Umbræ* broke out suddenly in the sun; for on *April* the 9th the disk was free; but *April* the 11th he perceived them advanced near $\frac{1}{4}$ part on the disk; and consequently they broke out in the sun within 48 hours before; on *April* 13, the spots were become *Umbræ* in the morning; and at four in the afternoon, there were no remains either of *Maculæ* or *Umbræ*: From this short continuance of these spots on the sun, it is more than probable, they were in a perpetual flux and change; and that those mutations Mr. *Derham* perceived in them, whilst he was looking on them, were real, and not imaginary; it may likewise be further remarked (which Mr. *Derham* frequently observed, and which *Scheiner* observed long before

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fore) that these spots and *Umbræ*, which suddenly arise, do as suddenly decay, and are soon extinct; and such spots he farther observed, seldom turn to *Faculæ*, as they commonly do when longer on the sun: Again *May* 5th, 1705, he could perceive two spurs or branches, running from a spot, to change, and be sometimes darker, sometimes thinner; so *March* 30, 1706 he observed such another variation; this day, or but a little before, spots with *Faculæ* arose in the sun, which did not continue thereon above three days; one of these spots he could plainly perceive to be sometimes quite extinct, and then again immediately to appear; and the *Faculæ* also, in half an hour's time, plainly altered their shapes: *October* 29, the same year, he could plainly perceive both the *Maculæ* and *Faculæ* to change; and whilst he was carefully viewing them, he saw a spot arise in one of the brightest *Faculæ*, and again almost disappear, and then again appear strong and spiss; but he could not see them next day, the weather being stormy, cloudy and wet for several days after: Another thing he observed was, that the *Maculæ* do generally, if not always become *Nebulæ*, or *Umbræ*, before they quite vanish; and after that, they very frequently turn to *Faculæ*, or bright golden spots, more illustrious, and fulgid than the other parts of the sun's globe; if the spots are of a short duration, *Faculæ* seldom ensue; or if they do, they are commonly the remains of some spots that had been on the sun, and perhaps vanished on the side opposite to us; but spots that continue long, if they vanish before that part of the sun revolves out of our sight, do very often become *Faculæ*; of which the above table shews several instances, particularly *July* 3d, 1705.

From the above particulars, and their congruity to what we perceive in our own globe, Mr. *Derham* gathers, that the spots on the sun are caused by the eruption of some new *Vulcano*, therein; which at first emitting a prodigious quantity of smoke and other opaque matter, causes the spots; and as that suliginous matter decays and spends itself, and the *Vulcano* at last becomes more torrid and flaming, so the spots decay and turn to *Umbræ*, and at length to *Faculæ*; which last Mr. *Derham* takes to be no other than the more flaming and brighter parts of the sun; he observed that these *Faculæ* never continue long on the sun; and the reason he takes to be this; *viz.* because the *Vulcano*, after its smoke is over, does not emit its flames for any time, the fiery *Pabulum* being then nearly spent, when once it begins to flame; after which the torrid *Vulcano* soon returns to the natural tempe-

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nature of the ſun, at leaſt ſo nearly, as to eſcape our ſight, at ſo vaſt a diſtance as the ſun is from us: Another thing that may be accounted for, and which indeed, in ſome meaſure confirms what Mr. *Derham* has already advanced, is the *Nuclei*, or darker part of the ſpots; generally obſerved in moſt of them, and that towards the middle: Now it is very uſual in culinary fires on this our globe, when they emit ſmoke, that the middle is the darkeſt part; if for inſtance, we were from aloft in the air, to ſee a thick ſmoke come tumbling out of a chimney, or the mouth of a *Vulcano* juſt kindled, we ſhould find the middle part, directly over the mouth of the chimney, or *Vulcano* to be the more ſpiſs and dark, and towards the extreme parts clearer and thinner; and ſo Mr. *Derham* takes it to be in the eruptions of the ſun; that the *Nucleus* is juſt over the mouth of the igniveomous cavern, and that the miſty parts of the ſpot are the thinner parts of the ſmoke, ſwimming about in that fluid, or atmoſphere, which he ſuppoſes to ſurround the ſun, as well as our globe, and manifeſtly the moon; yea, and in all probability, every planet of this our ſolar ſyſtem."

From what has been ſaid, we may give a reaſon, why there are ſometimes frequent ſpots on the ſun, and at other times none for many years, or at leaſt not always ſeen; but he thinks, there are ſometimes great intervals, when the ſun is entirely free; as between the years 1660 and 1671, 1676 and 1684; in which time ſpots could hardly eſcape the ſight of ſo many curious obſervers of the ſun, as were then perpetually viewing him with their teleſcopes in *England*, *France*, *Germany*, *Italy*, and all the world over, whatever there might be before, from *Scheiner*'s time; the reaſon of this long diſappearance of the ſpots, Mr. *Derham* takes to be the want of extraordinary eruptions in that fiery globe; when the ſulphureous, or other matter of thoſe eruptions is ſpent, or diſſipated, that globe continues in its natural ordinary burning ſtate, till there happen to be a freſh collection of ſmoaking, diſploſive, and extraordinary matter, and then it cauſes a new eruption; and theſe eruptions generally happen between the ſun's *Tropics*, or in his *Torrid Zone*; for Mr. *Derham* never obſerved any ſpots near the ſun's *Poles*; and the ſpots in *Scheiner*'s figures are all about the middle zone of the diſk; the greateſt evagation Mr. *Derham* ever obſerved, was *March* 8th, 170$\frac{3}{4}$; when beſides the dark ſpot in the uſual zone, he obſerved ſome faint ſpots, ſcarce viſible, much nearer the ſouth pole, than ever he had ſeen them before; but this was doubtleſs, in ſome meaſure owing to the poſition of the earth in

reſpect

respect of the sun, as well as to the southerly place of the spots on him; for about the equinoxes the spots seem to march pretty far towards the poles of the sun, as may be seen by Plate XI. Fig. 1, 2.

Having thus observed, what part of the sun the spots commonly possess, Mr. *Derham* in the next place takes notice of their stages and path over the sun: That the sun moves round his own axis, is manifest from the motion of the spots; and that the spots seem to traverse the sun, sometimes in strait lines, sometimes in curve lines, this way and that, is also as manifest and well known, and represented by the figures 5 which shew the stages of the spots, every day he observed them, and the lines they describe in several months of the year; the daily stages in both figures are exact; or if they seem otherwise, it is because the observations were made at different times of the day; as one in the morning, the other on some following day in the evening, or afternoon; but the declinations of the spots, or their distances from the sun's northern or southern limb are less exact in the 2d Fig. than the 1st, in which latter they are very near the truth; and the causes of the defects in the 2d, figure are, 1. The diminution of the sun's vertical diameter by the refractions; tho' Mr. *Derham* was sufficiently aware of this, yet he did not think it had been so considerable, for want of experimenting, or well considering the matter; for he has sometimes found the perpendicular, or vertical diameter of the sun diminished from 32′ 22″ on the meridian, to 26′ 3″ at the horizon in one and the same day. 2. For the same reason Mr. *Derham* was not aware of the time being so long, before the sun goes round, as he found it to be. 3. Another error was measuring the sun's image on the scene of white paper, with the shade of the micrometer, and not by looking thro' the tube, and so clasping the limb of the disk with the parallel edges of the micrometer; the former, tho' practised by some eminent astronomers, is a far more easy than accurate way.

Mr. *Derham* saw other spots on the sun, whose times are expressed in the following table.

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1707.		1709.	
December	4	*January*	15
	10		21
			22
	* 29		
	* 30	*August*	13
			* 17
1708.		*October*	8
July	31		
August	1	*November*	1
	5		2
	6		4
			5
			6
	22		
	23	1710.	
	24		
	28	*January*	22
September	1		
		April	* 6
November	5		
		October	14
December	14		* 18
	26		

From his obſervation of theſe ſpots, he was farther confirmed in his above-mentioned opinion; particularly, in viewing the ſpots of *Auguſt* 1ſt, 1708, repreſented by Fig. 3, where ſome were large and dark, others leſs and thinner, and all encompaſſed with *Nebulæ*; in viewing theſe, he obſerved great alterations at the very time he was looking on them; ſometimes the *Nuclei* were very dark and black, and ſometimes leſs ſo; and the ſame thing he alſo obſerved in the *Nebulæ* incompaſſing them; one of the leſſer ſpots *b* in Fig 3, which was ſufficiently viſible and ſtrong the day before, was this day, at one time thick and ſtrong, and anon languid and leſs viſible; and from the two ſpots *a* and *d* he could plainly ſee a ſmoke iſſuing out to *c* and *f*, ſometimes viſible for five or ſix minutes, and then diſappearing for $\frac{1}{4}$ of an hour, or more; and then again ſmoaking out, and again diſappearing, as before; all which particulars he ſaw over and over again, for a good while together.

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Mr. *Derham* could not see these spots till *August* 5, following; and then he found the spot *b* Fig. 3. quite extinct, as he expected, as also some of the other spots, together with the *Nebulæ* grown less; but the large spot *a* continued dark and strong, only sometimes fainter, and then again stronger; and sometimes like a half, or horned moon; sometimes roundish, or rather of an oval figure; of which latter shape they commonly are, when near the sun's limb, from which this spot was not far off at this time: These particulars are confirmations of what Mr. *Derham* affirmed; *viz.* that the solar spots are no other than a smoke arising from the body of the sun, of which opinion he had almost been ever since he first observed them, and of the same opinion was Mr. *Crabtrie*, as appears from his letter to Mr. *Gascoigne*, the inventor of the micrometer, dated *August* 7th, 1640.

'I have often observed, says he, these spots; yet from all my 'observations I cannot find one argument to prove them other 'than fading bodies; but that they are no stars, but unconstant '(in regard of their generation) and irregular excrescencies ari'sing out of, or proceeding from the sun's body, several things 'seem to me to make it more than probable; for 1. As to their 'form, they are seldom round, but of irregular shapes, and I 'have often seen one side, or end of the spot more thin than 'the rest, like a certain misty darkness, gradually thicker, 'grosser and darker, nearer the main body of the spot; just as 'the smoke of some pitchy fire, which is in one part very gross, 'and in another more rare and thin, becoming at length mere 'air; or like a cloud, fog, or mist, more thick, dark and gross 'in the middle; and more thin, fluid, penetrable, and transpa'rent towards the sides; which I suppose, is not compatible 'with any of the stars. 2. As to their colour; the lightness 'thereof distinguishes them from stars, or planets; they being 'never of such absolute darkness, as I observed *Venus* the 24th 'of *November* last; tho' I have seen spots sometimes little less 'than *she*, yet always of a far paler, and whiter colour, ap'pearing, at least in some parts like some thin dissipated sub'stance. 3. As to the manner of their appearance; I have 'seen several spots, which in the middle of the sun appear of a 'round form, but coming towards the limb of the sun, appear 'long; which is a demonstrative argument, that they are not 'globes, as all the planets and stars are; for globes always ap'pear of one form, *viz.* round in every position; but exhala'tions, or such like fluid substances, extended to a broad flat 'form, like our clouds, which being over our heads and so in

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'their full breadth, appear large and broad, but driven with 'the wind, till they turn one edge towards us, ſeem to be of an 'oblong form; ſo theſe ſolar clouds, revolving round the ſun, 'may in the middle ſhew their full breadth to us, and about both 'edges of the ſun, turn their edges towards us; which anſwers 'to the appearance. 4. As to their continuance; ſome of theſe 'ſpots, ariſing at the eaſt-ſide of the ſun, vaniſh before they 'come to the middle thereof; others appear firſt in the middle 'of the ſun, and vaniſh before they come to the weſtern limb; 'and for the moſt part they vaniſh before they have performed 'their entire revolution round the ſun; which argues them to 'be but thin, vaniſhing, fading ſubſtances, not like the perma-'nent bodies of the ſtars.'

'But to take off theſe reaſons, you anſwer, that you conceive 'theſe ſpots to be ſtars, moving regularly in their own orbs; 'which are many, tho' none of greater extent than about $\frac{1}{10}$ of 'the ſun's ſemidiameter from its circumference; and that the 'ſwifter movers in the lower orbs, overtaking the ſlower ones in 'the higher orbs, cauſe an appearance; you therefore ſeem to 'think, that they being ſuch thin bodies, the rays of the ſun 'paſs thro' them, and ſo one cannot be ſeen alone, till more be-'ing together, heaped one behind the other, they intercept the 'light of the ſun's rays, and ſo cauſe an appearance; this ſays 'Mr. *Crabtrie*, I conceive is your meaning; or elſe (as you 'ſeem to inſinuate afterwards) that the higher reflects the ſun's 'rays ſtrongly enough upon the lower (when they come within 'the angle of reflection) to render the intermediate planet in-'diſcernible.'

'But to theſe I anſwer, 1. If it be by their coming within 'the angle of refraction, that the light of the ſun reflected from 'the outer planet upon the inner, makes it indiſcernible; then 'that light ſo reflected, is reflected either upon all places, as 'the light of the moon and planets is; or but upon one place, 'as is the reflection of a plane looking glaſs: If the firſt, there 'never would be many ſeen (ſeldom above one or two) becauſe 'the outermoſt would continually make the innermoſt indiſcerni-'ble; but *Gaſſendus* affirms, there are ſometimes 40 ſeen at once 'in the ſun's body: If the ſecond there would always be ſeveral 'ſeen, becauſe the reflected light would poſſeſs but a ſmall 'ſpace, and that but for a little time, till the ſwifter ſpot were 'paſt the place of reflection; whereas, for ſeveral days there are 'none at all ſeen in the ſun's hemiſphere; and in both theſe 'caſes, the outermoſt planet of all would always in the ſpace of

27 days be ſeen in the ſame place, being never obſcured, none of the inferior ones being able to reflect light thereon: Add to this, if any kind of reflection ſhould make them appear bright like the ſun, and ſo not diſtinguiſhable from the light of the ſun, what ſhould hinder, but we ſhould ſee them, as repreſented Fig. 3, alſo bright bodies by the ſide of the ſun, when they are paſſing either by the weſt, or eaſt ſide of the ſun's body? The light being at that time reflected upon them by the inferior planets, as well as at other times, and that alſo upon much of that ſide of them we ſhould behold: But if you wave this conceit, as inſufficient, and fly to your former; *viz.* that the ſwifter movers in the lower orbs, overtaking the ſlower in the higher ones, cauſe an appearance; to this I anſwer, 1. What you ſuppoſe, ſeems to me, neither neceſſary nor probable; nor do I conceive, why they ſhould not be ſeen, being alone, as well as conjoined, ſeeing all other ſtars and planets are ſo. 2. If it be, becauſe they are of a thin tranſparent ſubſtance, till ſeveral being one behind another, makes them to ſeem groſſer; then they are not of the nature of other planets, as is proved in *Mercury* and *Venus*, who of themſelves appear dark bodies, when they come between us and the ſun; nay, they muſt be thinner, than our clouds, which will eaſily be ſeen between us and the ſun, and hide it from us. 3. If it be becauſe they are ſo ſmall, that the imperfection of our glaſſes cannot diſcover one alone, there muſt be doubtleſs, ſeveral millions of them, which how they can be included within the compaſs of $\frac{1}{10}$ of the ſun's ſemidiameter, ſhall be conſidered anon: I have ſeen one ſpot of an ordinary darkneſs (yea, darker than ſeveral larger ones) yet not above 5″ in diameter; if this conſiſt of two, or more of themſelves inviſible, how many were in thoſe which *Gaſſendus* ſaw of 1′ and a half in diameter? 4. The ſhape of theſe large ſpots (being neceſſarily compoſed of ſtars of ſuch different orbs and motions) would quickly vary, becauſe of the diverſity of their motions; juſt as we ſee in a flock of ſmall birds: But 5. You ſay the fartheſt of theſe orbs is not above $\frac{1}{10}$ of the ſun's ſemidiameter from its circumference; but there would not in that ſmall ſpace be room enough for ſo many orbs of planets, as have been ſeen at once; which I prove thus. 1. *Gaſſendus* affirms, there are ſometimes ſome ſpots of about $\frac{1}{10}$ part of the ſun's ſemidiameter, which is the whole ſpace allowed by you for all; and I myſelf have ſeen of the $\frac{1}{7}$ of the ſun's ſemidiameter; and yet you muſt own that theſe large

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ones could only be conjunctions of some, not all. 2. There are several times seen a great many spots in the suns superficies, whose diameters added together, would more than twice fill the space you speak of; this I myself have seen: *Gassendus* affirms, that sometimes there are 40 seen at once; if this was by conjunction of planets, in every appearance, there were at least 80 bodies at once on this side the sun; and perhaps as many on the other side, besides those unseen (by your reflection or otherwise) which doubtless, must be many more than those that are seen; for it is a most rare, and I think unheard of thing to see but three (which is less than the half) of our planets in visible conjunction at once; so that without question, if they be planets, they are several hundreds, which must have so many respective orbs, and which certainly, cannot be in so narrow a compass, as the $\frac{1}{10}$ of the sun's semidiameter; and that they cannot have any larger, I suppose, not so large an extent from the sun's superficies, may be proved by their motion thro' the visible hemisphere of the sun's spherical body, by comparing the swiftness of their motion towards the middle and the sides together. 6. If one of these supposed planets be swifter than another, as they must needs be, then the conjunction of two or three swifter ones would form a spot of a quicker motion, than the conjunction of two slower ones; but the motion of all about the sun's center, is always equal; yea, and the spots retain the same position to each other, (considering the sun's sphericity, and the angle of their appearance to us) just like the fixed stars; thus *Gassendus* affirms, that all the spots move with the same uniform velocity, so that when there are several of them, no one moves faster than the other, but they retain the same equable motion with respect to each other; on the sun's disk, as the fixed stars do in the firmament.'

'As to that other annual motion of the spots you speak of, from west to east upon their axis, inclined above eight degrees to the ecliptic; I suppose it is not any real motion of the orbs of those solar planets or spots, but only an apparent motion, caused (in *Kepler*'s system) by the sun's revolving round its own center in the middle of all the orbs, not exactly in the way of the temporary ecliptic, but in the *Via regia* (as *Kepler* calls it) inclined a certain number of degrees to the temporary ecliptic; thereby carrying about with him the same way his adventitious, or excrementitious parts, the spots, and that by his magnetical or sympathetical rays; and hence may be demonstrated

'monſtrated the appearance of that annual motion in the ſun's 'ſpots you ſpeak of; *Vide Galilæus's Syſt. Coſm. p.* 339, *& ſeq.* 'So likewiſe in *Ptolemy*'s and *Tycho*'s ſyſtem, the ſame ap-'pearance may be demonſtrated, ſuppoſing the earth fixed in the 'middle of the univerſe, and the ſun revolving upon the ſame 'poles of that *Via regia*, or way of the ſpots, and keeping his 'axis continually parallel towards one and the ſame part of the 'univerſe; this may be certainly demonſtrated, tho' *Galilæus* 'there affirms the contrary: Other hypotheſes of that motion 'may be invented, as by the annual converſion of the poles of 'the *Via regia* about the poles of the ecliptic in the ſun's body; 'but I take none to be ſo compendious, as the one of the 'former; for my part I incline to the firſt.'

'*Fromundus* mentions one *Jo. Tarde Gallus*, who takes them 'to be ſecondary planets, and who has writ a book on that ſub-'ject, and calls them *Aſtra Borbonia*; but I could never yet 'ſee it.'

'What you ſay is true, to wit that I found *Venus*'s diameter 'much leſs than any theory extant made it; *Kepler* came 'neareſt, yet he makes her diameter five times too much; *Ty-'cho*, *Lansberg*, and the ancients about ten times larger than 'it was; ſo likewiſe they differ as far from the truth, with re-'gard to the time of the conjunction; according to *Lansberg* 'the conjunction ſhould have been 16 h. 31′ before we obſerved 'it; according to *Tycho* and *Longomontanus* 1 d. 18 h. 25′; ac-'cording to *Kepler*, who is ſtill neareſt the truth, 9 h. 46′ be-'fore: The clouds intercepting deprived me of part of the ob-'ſervation, but Mr. *Horrox*, being near *Preſton*, obſerved it 'clearly from the time of its coming into the ſun, till ſun-ſet; 'and our obſervations agreed very exactly both in the time and 'diameter.'

'In eclipſes, eſpecially thoſe of the moon, *Lansberg* comes 'often nearer the truth than *Kepler*, yet it is by packing errors 'together; his diameters of the ſun and moon being falſe, and 'his variation of the ſhadow being quite repugnant to geome-'trical demonſtration; Mr. *Horrox* did for a long time endea-'vour to correct, and amend his circular hypotheſes, changing 'and turning them every way till we found, by comparing ob-'ſervations in ſeveral places of the orbs, that his hypotheſes 'would never agree with the heavens for all times, as he confi-'dently boaſts; no nor ſcarce for any one whole year together, 'if you alter the equable motion, *Proſthaphæreſes*, and excen-'tricity which way ſoever you will.'

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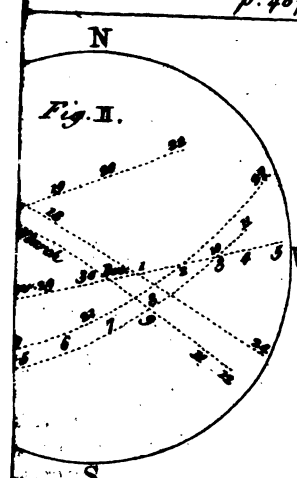

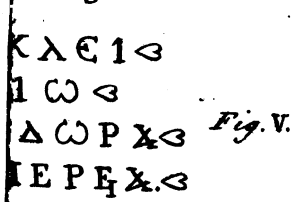

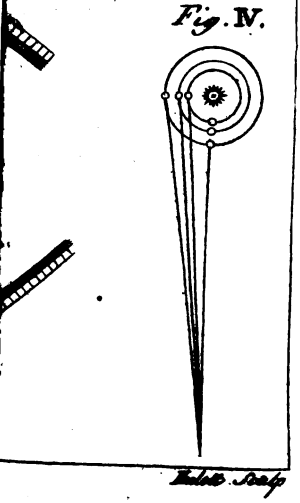

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'*Kepler*'s elliptic orbit is undoubtedly the path which the 'planets deſcribe in their motions; and if you have read his '*Comment. de motu Martis*, and his *Epit. Aſtronom. Coperu*-'I doubt not but you will ſay his theory is the moſt rational, demonſtrative, harmonious, ſimple and natural that has been 'yet invented, or I ſuppoſe can be; all thoſe ſuperfluous fic-'tions being rejected by him, which others are forced ſo abſurdly 'to introduce; and tho' in ſome reſpects his tables be deficient, 'yet being once corrected by due obſervations, they hold true 'in the reſt, which *Lansberg* and all others want.

'Your conceit of turning the circle into 100,000,000 parts 'were an excellent one, if it had been ſet on foot, when aſtro-'nomy was firſt invented; Mr. *Horrox* and I have often con-'ferred about it: But in reſpect that all aſtronomy is already in 'a quite different form, and the tedioufneſs of reducing the 'tables of fines, tangents, and all other things we ſhould have 'occaſion to uſe, into that form; as alſo ſome inconveniencies 'which we foreſaw would follow in compoſing the tables of 'celeſtial motions, together with the greatneſs of the innova-'tion, deterred us from it; only we intend to uſe the centeſms 'or milleſms of degrees, becauſe of the eaſe in calculation: 'I have turned the *Rudolphine* tables into degrees, and mil-'leſms, and altered them into a far more conciſe, ready, and 'eaſy form, than they are done by *Kepler*.

Fig. 1. repreſents the ſtages and lines deſcribed by the ſpots on the ſun in *January* 170$\frac{3}{4}$, and in *May*, *June* and *October* 1705.

Fig. 2. repreſents the ſtages and lines deſcribed by the ſpots on the ſun in *September* and *November* 1706, and in *February* and *March* 1706-7, and in *September* and *November* 1707.

Fig. 3. repreſents the appearance of the ſpots in the ſun from 1707 to 1711.

Fig. 4. repreſents a rough draught, inſerted by Mr. *Gaſcoigne* in the margin of Mr. *Crabtrie*'s letter, in order to explain his hypotheſis, and what Mr. *Crabtrie* ſays againſt it.

Antiquities *found at* Corbridge *in* Northumberland; *by Dr.* Todd. Phil. Tranſ. N° 330. p. 291.

THE pretended entire ſkeleton of a prodigious monſter of human form, about 22 foot long, was diſcovered on the north banks of the river *Tyne* at *Colcheſter* in *Northumberland*, former-

formerly a *Roman* colony, but now a field of corn, no antiquity remaining, but some walls and rubbish, which shew it to have been a very large fortress; the stones which have been dug up there with figures and inscriptions upon them, have all been removed to *Corbridge*, which has risen out of its ruins, at a mile to the east of it; there Dr. *Todd* saw altars with the following inscriptions, *viz.* one IMP. MAVRELIO .... another LEG. II. A V G. COH. IIII. But the most remarkable, is that which stands in a corner of the church-yard, and dedicated to *Hercules* in old capital *Greek* characters, Plate XI. Fig. 5. i. e. *Herculi Tyrio divina dona archi-sacerdotalia, vel per summum sacerdotem offerenda*: The altar seems to have been erected by some of the *Asiatic Phœnician* auxiliaries, who might be in garrison here, near the frontiers, under *Urbicus Lollius*, in the time of *M. Aur. Antoninus* about A. D. 140. The altar is very large, hollow at the top as usual, for incense; on the sides are engraven a bull's head, with garlands and sacrificing implements.

The teeth and bones, which were discovered by the river *Tyne*'s breaking in on the bank, were found near the foundations of the old fort, and neither higher up, nor lower down than its ruins seemed to reach: The Dr. examined the person who made the first discovery, and was as exact as possible in the remarks, he himself made on the spot: Upon the whole it appeared to him that there never was an entire skeleton found in that place; the teeth and bones lay in the bank in *Strata*, sometimes at one, sometimes at 2 yards depth, for upwards of 200 yards in length; in some places there appeared to have been a sort of pavement or foundation of stone, which ran along with the bones in layers, sometimes above them, and sometimes below them; the bones were of different sizes; the teeth which were most perfect and entire, were very large, some three or four inches in compass; several ribs, shank-bones, *&c.* not exceeding the ordinary dimensions of those of sheep and oxen were found: He could meet with no remains of horns, those being more easily corrupted than the bones, which are of a harder substance; the teeth looked as if they were human; but this he could not aver; and they sometimes lay at so great a distance from the ribs and shank-bones, that should any one compute the length of the monster from one to the other, it might be calculated to 200 or 300 yards, as to 22 foot: The teeth and bones were in such quantities, that a bushel of them might be gathered in a few hours.

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From this account the Doctor infers, that this altar, dedicated to the *Tyrian Hercules*, was very famous, and much frequented; that oxen, and such like animals, as *Bisons* and *Bonasi*, (with which the country hereabouts formerly abounded, the entire head and horns of one being dug up in a marshy ground, exactly resembling those animals, as described by *Gesner* and others) were sacrificed thereon; and that their bones, being all thrown together, and, according to the superstition of those times, laid under the foundation, and pavement of the fort, are the very same bones, teeth, sculls, ribs, &c. which, by the river's washing away, the bank, were discover'd; and the Dr. thinks it not impossible, that (as *Erkelens* in *Gilderland*, was *Herculis Castra*, and *Herland* in *Cornwall* was *Herculis Promontorium*) so upon the recess of the *Romans*, these *Saxons* who succeeded them might call this noted station *Herculceaster*, and by corruption, *Colceaster*, or *Colchester*, its modern name; and what may somewhat confirm the conjecture, the adjacent town of *Corbridge*, which, as was said, rose out of its ruins, is call'd in the charter of *Henry* I. (whereby that king gave it to the secular canons of *Carlisle*, before the erection either of the priory or bishoprick) *Colbruge*, and *Colburgh*, and the same as *Col-ceaster*, the bridge, from which it may seem to take its denomination, being of a much later erection: That oxen were wont to be sacrificed to *Hercules*, their needs no more evidence than the altar itself, whereon an ox's head, with sacrificing implements, are delineated: As to the teeth, and bones, if it does not appear, that they agree perfectly with the teeth and bones of oxen, it will not therefore follow that they must be human, and that they were men of prodigious stature, to whom they belonged; seeing there were in those parts other animals of a very large size, to whom they might belong, and of whose teeth and bones there are now very few specimens to compare them with.

An Account of the Mosses in Scotland, *by the Earl of* Cromartie. Phil. Trans. N° 330. p. 296.

THERE are several grounds in *Scotland*, called mosses, from which they dig turf and peats; the surface is covered with a heathy, or, as they term it, heathery scurf, under which there is a black, moist, spongy earth, in some places shallower, and in others deeper, from three or four to

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ſeven or eight foot deep, and in ſome few places, twice or thrice that depth; they cut the heathy ſcurf with a flat kind of ſpade, which they force horizontally between the ſcurf and the aforeſaid ſpongy earth, and turn up the ſcurf in flat thin flakes, which they call turf; this turf, over-run with the ſmall roots of heath, or heather, and dried, makes a healthful brisk fire; but with a deal of aſhes, of a whitiſh, duſkiſh, or reddiſh colour, always the whiter, as it contains more of the woody roots; the black, ſpongy earth, which lies under the turf, they cut out in oblong ſquares, with iron ſpades made of that ſhape, about eight or nine inches long, and about four or five inches broad; and as they are cut up, the weaker men, women, and children carry them in ſmall wheelbarrows, and ſpread them on ſome dry ſpot of ground, in order to dry by the ſun and wind; ſome of them become harder and ſome ſofter, according to the nature of the mold, or earth; the more ſolid they are, the better fire they make, and ſuch as are more ſpongy, are leſs eſteem'd; and when they have cut off one ſurface of four or five inches deep, they proceed downwards to another, till at length they come to the hard channel, or bottom, unleſs they be ſtopped by water, which they alſo commonly drain off by making a trench to ſome deſcent, if poſſible, and if not, there the water ſtagnates; and ſuch waſte pits, where the water hinders to cut the ſpongy earth to the bottom, will, in a good number of years, fill up again, with a new ſpongy earth, which in proceſs of time will become of the conſiſtence of peat-moſs as at firſt, and a ſcurfy heathy turf will at laſt grow on the top thereof: His lordſhip obſerved, that peat-pits dug in his own memory, were again grown up with new peats, and that ſometimes more than once in the ſame pits, ſome moſſes growing in a ſhorter time than others; he alſo obſerved, when they dig the peats to the channel, and in places where the water runs off, that there the moſſes did not grow, nor were renewed again; but Sir *Robert Adaire* informed his lordſhip, that without cutting the moſſes, in the manner of pits, only cutting them in quite to the channel, and laying the heathy turf, cut off the top of the moſs, on the channel, ſo as to cover it over, in proceſs of time a moſs would grow there again, but not ſo faſt as in the pits: His lordſhip always obſerved, that theſe moſſes ſtand in plains, tho' the heathy or heathery turf overſpread, for the moſt part, the face and declivities of the mountains; and that there are deſcents to and from them, both for conveying and carry-

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carrying off the water, which he takes to be the parent of peat.

In ſeveral of theſe moſſes, there are found quantities of fir and oak, and he never obſerved, nor heard of any other kinds in them; they are commonly found in large trees, but the ſmaller branches are ſeldom found unconſumed; he had ſeen ſeveral very large trees of both kinds; generally the oak is always black, the fir ſometimes whiter, and ſometimes redder, as it is obſerved in all firs, but neither fir nor oak are found with any bark; the fir is generally as freſh and tough, and as fit for uſe, as any other old timber; only it has imbibed ſo much water, that it takes a long time to dry and to be fit for uſe, eſpecially the oak; inſomuch, that when it is put into any ſmall work, it readily warps, and changes its figure; no oaks, ſtanding in the woods, are ever found to have that blackneſs, ſo that it is probable, that colour is owing to the water: There are ſeveral places, where woods do not now grow, and yet the moſſes in theſe places are well ſtored with this kind of ſubterraneous timber, both oak and fir, but eſpecially the latter; ſuch are the *Orkneys* and the *Lewes*, *Cathneſs*, *Tarbatneſs*, and the coaſt of *Buchan*; from which it ſhould appear that there have been ſtanding woods of old in theſe places, or how elſe could they come into theſe moſſes: And this ſeems to be confirmed by the following account,

In 1651 his Lordſhip being in the pariſh of *Lochbrun* in *Roſs-ſhire*, and going from a place called *Achadiſcald* to *Gonnazd*, paſſed by a very high hill, which roſe in a gradual activity from the ſea for upwards of a mile, only that there was an intermediate plain, about half a mile in circumference; this ſmall plain was then covered with a firm ſtanding wood, which was ſo very old, that the trees had not only no green leaves, but were quite ſtripped of their bark; and this he was told, was the general manner in which fir-woods terminated; and that in 20 or 30 years after, the trees would commonly caſt themſelves up from the roots, and lie in heaps till they were cut down, and carried away; they likewiſe ſhewed him, that the outſide of theſe ſtanding white trees, and for an inch deep was dead white timber, but all within that, good ſolid timber, even to the very pith, and as full of roſin as it could ſtand in the wood: About 15 years after, coming the ſame way, he did not obſerve ſo much as a tree, or the appearance of the

root of any; but inſtead thereof, the whole ground, where the wood had ſtood, was all over a green plain, covered with a green moſs; and aſking the country people, what became of the wood, and who carried it away; they told him that no body was at the pains to carry it away? but that the trees being all over-turned from the roots by winds, lay ſo thick and ſwarving over each other, that the green moſs (called in *Scotland* ſog) had overgrown the whole; which they ſaid, was occaſioned by the moiſture from the high hill above it, ſtagnating on that plain; and none could adventure to paſs over it, becauſe the ſcurf of the ſog would not ſupport them, and his Lordſhip attempting it, fell in to his arm-pits: Before the year 1699, that whole ſpot of ground was turned into a common moſs, where the country people dug turf and peats; the peats were not of the beſt ſort, being ſoft and ſpongy, but afterwards they improved and became better: This matter of fact ſhews both the generation of moſſes, and whence it is, that ſeveral are furniſh'd with ſuch timber: Theſe highland woods are commonly ſtored with other kinds of timber, as birch, elder, aſh, beſides ſhrubs and thorns; yet none of all theſe are found in the moſſes: It may be queried, why firs and oaks do not now grow in ſeveral countries, where they are found ſo plentifully in moſſes: In a moſs near the town of *Elgin* in *Murray*, tho' there be no river or water that runs into the moſs, yet at three or four foot deep, there is a ſort of ſmall ſhell-fiſh, reſembling oyſters, found in great quantities in the very body of the peats, and the fiſh alive within them; tho' no ſuch fiſh be in any water near that moſs, nor in any adjacent river, nor in the ſtagnating pits in that moſs, but only in the very ſubſtance of the turf.

Of the Bogs *in* Ireland; *by Dr.* Hans Sloan. Phil. Tranſ. N° 330. p. 302.

WHAT the Earl of *Cromartie* obſerves of the moſſes or bogs in *Scotland*, Dr. *Sloan* confirms by what he found in the north of *Ireland*; where he had been an eye-witneſs, that when the turf-diggers have reached the bottom or firm ground, after having dug out all the earth proper to make peat, and are come to the clay or other ſoil, on draining off the water, there appeared roots of fir-trees, with their ſtumps ſtanding a foot or two ſtrait upright, and their branches ſpread out horizontally on every ſide on that firm ſurface, as if that had formerly been the outer face of the ground, and place of their

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their growth; and he observed these roots sometimes so near each other, as that their branches were matted, as it were, grew over, and gave place to each other, as we daily see in the roots of trees, where they grow too close: The Dr. once saw the body of a fir-tree dug up, so large as to be judged fit for the main post of a wind-mill, which was discovered, as several of them (which are not found in digging turf) are, by the grass, which grew over it, being in a very dry summer of a yellowish colour.

Mr. *De la Pryme* sent the Dr. some of the cones found with this timber in the large fens of *Lincolnshire*, and which differed in nothing from those of the *Scotish* fir. *Cæsar*, indeed, in his *Commentaries*, says that the sorts of timber in this island, are the same as in *France*, *præter fagum & abietem*, *i. e.* excepting beech and fir: But the Earl of *Cromartie*'s account, as to firs, and the beeches in the *Chiltern* countries near *London*, do sufficiently disprove this: As to the uses of this subterraneous timber, besides those of other wood, it is split into pieces, and being lighted, supplies the use of candles; it is also made into ropes, as may be seen in the *Musæum* of the *Royal Society*, by a long piece of such rope bought in *Newry-market* in *Ireland*, the long soaking in water having rendered the wood of those trees fit to be made into ropes; this seems to prove, that as the soaking of hemp, flax, aloe-leaves, *&c.* in water, dissolves the pulpy part, and leaves the fibrous part fit for being made into threads, and ropes, so the long soaking of trees may in length of time make the same, or an analogous change in those of wood and timber. The Dr. had seen what he took to be pieces of wood, not only in clay-pits, but even in quarries or stone-pits, in the blocks of stone raised out of their *Strata*, or layers; and he had been assured by Mr. *Bellers*, that he saw large pieces of wood in the stone-pits in *Gloucestershire*; and that in *Lancashire* there is a moss, or turf-bog, where the black spongy mold, made use of for peats, smells very strong of *Bitumen* or *Petroleum*, of the oil of which it yields a very considerable quantity by distillation; and Sir *Edward Hannes* informed the Dr. that near the Lord *Blessington*'s house, in *Blessington* in *Ireland*, there appeared a light, where the horses trampled with their feet on a certain spot of soft ground; and having procured some of this mold, it exactly agreed in its dark colour, lightness, *&c.* with peat earth; and upon viewing it with a microscope, he found the light proceeded from several small, half transparent, whitish, live worms, which lay therein.

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The blackneſs of the oak, is owing, the Dr. ſuppoſes, to the vitriolic juices of the earth ſoaked into it, and which being aſtringent turn it black: Ink is made of galls, an aſtringent excreſcence of a ſort of oak in *Turkey*, made by an inſect there, and of green vitriol, made of the *Pyrites* diſſolved by rain-water, and of iron: Earth of all ſorts, and even human calculi and the aſhes of vegetables, have particles of iron in them, in greater or leſſer quantities; the *Pyrites* is alſo very common: The particles of iron coming to be diſſolved by this *Pyrites*, ſubacid, or other ſalts diſſolved by water, or perhaps, by water itſelf, and conveyed into theſe bogs, faſten there to the tree, ſoak into it, and turn it black: Theſe particles in ſome river-water, faſtening to the oak timber, floated therein, give the ſame a darkiſh colour, as obſerved by Mr. *Pepys* in his *Naval Memoirs of England*, p. 71. where we are told by the moſt famous ſhip-builders of *England*, 'That the beſt foreign plank for the Royal Navy, 'was brought either from *Dantzick*, *Quinborow*, that is, *Koningsberg*, or *Riga*, of the growth of *Poland* and *Pruſſia*, or 'from *Hamburg*; namely, that ſort of it, which is ſhipped from 'thence of the growth of *Bohemia*, diſtinguiſhed by its colour, 'as being much more black than the other, and rendered ſo, as 'is ſaid, by its long ſobbing in the water, during its paſſage 'thither.'

In the turf bogs of *Ireland* 14 foot deep, there are found not only the mouſe-deer's horns, mentioned in a former *Tranſaction*, but likewiſe their whole ſkeletons, wherein the bones bear the ſame proportion to the like bones of other deer, as the horns bear to their horns: There are likewiſe found therein, gold-chains, pieces of money, and roots of heath, ſeveral *Muſci*, or moſſes, and branches of trees, ſo ſoft as to give no reſiſtance to the turf-ſpade; and the Dr. was told, that in cutting turf in one bog, they at ſeveral feet deep, cut thro' what the *Iriſh* call a *Ruſkin* of butter, which was a firkin, or veſſel made of the bark of trees, uſed by the old *Iriſh* for putting up their butter in; and in digging the wet dock at *Deptford*, there were found at the bottom, about nine foot deep, graſs-leaves, hazel-nuts, and roots of trees, and likewiſe a piece of money, as they termed it, which proved to be a leaden ſeal affixed to ſome *Bull* of Pope *Gregory* IXth, who continued Pope from A. D. 1227 to 1241.

From *Leland* in his *Itinerary Vol.* 5. *p.* 13. who wrote in the reign of king *Henry* VIII. we may learn the common opinion in his days, of the cauſe of the deſtruction of woods, the growing of moſſes and pools; and that at that time in *Wales*, the

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ſenſe of the natives was, that the ſubterraneous trees found there, had formerly grown there: 'In theſe deyes in *Mone*, 'where they digge turves be founde greate rootes of trees, that 'ſerve men for wood; for after the trees wer cut doune, ſogging 'yerth and moſſe overcoverid them, and now the ſame yerth 'parid away for turves, the old mayne roots appere; likewiſe 'at low water about all the ſhores of both ſhores of *Aberdein* 'and *Towen Merioneth* appere like rootes of trees; I ſaw hard 'by on the lift honde a greate fenny more, owt of wich the in-'habitantes thereabout digge turfs for fier, and by the ſame 'fenne is a fair *Llin* caullid *Llinridde* ii miles from *Strate-'flur*; *Strateflur* is ſet round about with montaneous not far 'diſtant, except on the weſt parte, where *Diffrin Tyve* is; 'many hilles thereabout hath bene well woddid, as evidently by 'old rootes apperith, but now in them is almoſt no woode; the 'cauſſes be theſe. 1. The woode cut doun was never copiſid, 'and this hath beene a greate cauſe of deſtruction of woode tho-'rough *Wales*. 2. After cutting doun of wooddys the gottys 'hath ſo bytten the young ſpring, that it never grew but lyke 'ſhrubbes. 3. Men for the nonys deſtroied the greate wooddis, 'that thei ſhould not harborow theves. From *Whitchurch* a 'mile and a half of, I cam by the pale of the large parke of '*Blakmer* longging to the Erle of *Shreusbiri*, wherein is a 'very fair place or loge; the parke hath both redde dere and 'falow; in the parke (as I herd ſay) be iii faire pooles, of the 'wich I ſaw by the pale the largeſt caullid *Blakein*, whereof 'the parke is namid; it is to be ſuppoſid that thes pooles for 'the moſt parte in moriſch groundes, and lying ſumwhat in low 'groundes, dreane the moiſt places about them, and ſo having 'no place to iſſue owt ſtagne there: Some be likelyhod have 'begon of marle pittes; for the ſandy grounde of ſum partes of '*Shropſhire*, and eſpecially of *Cheſtreſhire* and *Lancaſtreſhire* 'will not bere corne plentifully, but it be merlyd. From *Bla-'kemere* to *Byklem* in a foſſe iii miles of ſand hard by *Cholme-'ley*, firſt I ſaw the greate numbre of firre-trees, the wich the 'inhabitants thereby communely digge up for fier wood, but 'there did I ſe no fyrre-trees growing. Oftentimes in diggin in 'this moſſe or more for petes or turves they find the hole trees 'of the firſt, ſum ſhort and ſum veri long, without twike or 'bow, lying ſumtime not a foote, ſumtime iii or iiii foote depe 'in the ground; but how or when thes trees cam doune, either 'be cutting or wind faulle no manne ther can telle; the wood of 'them in burning, ſavorith of reſine. *Morle* (in *Darbyſhire*)

Mr. *Le-*

'Mr. *Lelandes* place is buildid saving the fundation of stone 'squarid, that risith within a greate moote a vi foote above the 'water, all of tymbre after the commune sort of building of 'houses of the Gentilmen for most of *Lancastreshire*: There 'is as much pleasur of orchardes of greate varite of frute and 'faire made walkes and gardines, as there is in any place of '*Lancastreshire*; he brennith al turves and petes for the com-'moditie of mosses and mores at hand. For *Chateley* mosse 'that with breeking up of abundance of water then hid did 'much hurt to landes thereabout, and rivers with wandering 'mosse and corrupt water, is within less than a mile of *Morle*; 'and yet by *Morle* in hegge rowes and grovettes is meately good 'plenty of wood, but good husbandes keep hit for a jewel. Syr 'John Holcrofte's house within a mile or more of *Morle* stood 'in jeopardi with fleting of the mosse: Riding a mile and more 'beyond *Morle* I saw on the right hond a place nere by of Mr. '*Adderton*, and so a ii miles of to *Lidiate* mosse, in the right 'side whereof my gide said that ther were rootes of fyrre wood. 'Al *Aunderneſſe* for the most parte in time past hath beene ful 'of wood, and many of the moores replenishid with hy fyrre 'trees.'

Microscopical Observations on the Animalcula *in the Semen of young* Rams; *by M.* Leewenhoeck. Phil. Trans. N° 331. p. 316.

THE latter end of *June* 1711 M. *Leewenhoeck* procured the *Testes* of a young ram, and having made a small incision in the lower part of each of them, where was a protuberant roundness, and from whence the *Vasa deferentia* proceeded, he squeesed a little whitish matter out of them, which he immediately placed before a microscope, and he could very plainly observe a vast number of *Animalcula* both living and moving; and because the *Animalcula* could not be seen so distinctly, by reason of their vast numbers, and their quick motion in the little slimy matter, wherein they swam, he took a little rain water, about the quantity of a large pin's head, and mixed it with an equal quantity of the said matter; whereby being very much diluted, he placed it again before the microscope, and then he could very distinctly see the dead bodies of those *Animalcula*, lying in the liquor: About 10 or 12 days after, he got two other *Testes* of a young ram, which were somewhat smaller than the former; and he proceeded with them as before, and found that the whitish matter was much more fluid than the former,

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former, and that there floated therein a vaſt number of very clear ſmall globular bodies, of which he could not diſcover any of the ſmalleſt particles to be like thoſe *Animalcula* above-mentioned; from which obſervation he thought with himſelf, that as *Fœtus*'s lie in the *Uterus*, in ſuch a globular form, as is conſiſtent with our bodies; ſo in like manner, theſe globules which he ſaw, were *Animalcula* proceeding from the *Semen maſculinum*, that were not yet arrived to their perfect ſhape. Eight days after, he procured two other *Teſtes* of a young ram, which were ſmaller than the former, and having opened them in like manner, as he did the other; he not only found that no *Animalcula* appeared living, but likewiſe that the tranſparent globules were not the $\frac{1}{4}$ part ſo big, ſo far as he could conjecture by his eye, as the above-mentioned.

On the 13th of *July* he cauſed the two *Teſtes* of a ſucking lamb, about three months and a fortnight old, to be brought him, being a little more than half as big as the firſt; upon opening theſe likewiſe in that part where the *Vaſa deferentia* were thickeſt, and taking one of them out, and viewing it with the microſcope, he judged that thoſe globules, which he obſerved therein were ſo ſmall, that 25 of them were not equal to one of the large ones above-mentioned. Upon the 18th of *July* he made a ſimilar experiment with the former, the lamb being almoſt as old as the preceeding; but he could not diſcover any globules bigger than the laſt mentioned, nor any thing that appeared to be living. On the 20th of *July* he repeated his experiment on the *Teſtes* of a young ram, which was very near as big as the firſt of all, and opening them in the uſual place, he ſaw great numbers of living *Animalcula*; he likewiſe diſcovered in the fluid matter, which he ſqueeſed out of them, ſeveral floating globules, which he ſuppoſed might be ſome of thoſe imperfect *Animalcula* above-mentioned; all theſe young rams were killed the day before their *Teſtes* were brought him. On the 25th of *July* at nine o'clock, there were likewiſe brought him the two *Teſtes* of a young ram, killed the day before at 11 o'clock in the forenoon; theſe were larger than any he had ſeen that year: He immediately opened the part above-mentioned, and diſcovered the *Animalcula* in great numbers, and like clouds moving among each other, ſo as to afford a very agreeable ſight; and this he continued to do till 12 o'clock, and conſequently till the *Teſtes* had been 25 hours out of the ram's body, wrapt up in a paper upon an earthen diſh, and expoſed to the cold all the night: Then he took another *Teſtis*, on which

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he had hitherto made no remarks, and binding it up in a linen cloth, he kept it in a warm place, in order to view it the next day; and he observed the first *Testis* till five o'clock in the afternoon, at which time he saw some living *Animalcula*; but at 12 o'clock before, he discovered 100 *Animalcula* for one he saw at five o'clock; for between 12 and 5 o'clock, he made 25 several observations, and those almost always by making new incisions with a knife into the *Testes*, and by squeesing the matter out of the incision, tho' no bigger than a pin's head: Now, while these *Animalcula* were swimming in the aforesaid fluid matter, he often observed thro' the microscope, that the fore-part of their bodies was very lustrous, just like small fish swimming in water, when they turn upon their sides or bellies, and cast a glittering brightness to the eye; from which he supposed that the upper part of the bodies of the *Animalcula* in the *Semen masculinum* of rams are flattish, and that that brightness proceeded from their exposing those flattish sides to the sight, in swimming. Next morning at seven o'clock M. *Leewenhoeck* viewed the matter of the second *Testis*, which he had bound up in a cloth with his microscope; but he could not perceive any thing that had the least sign of life therein, and the *Testis* began to spoil.

Now since we perceive that the *Animalcula* in the *Testes* of a ram, can live 32 hours after the ram is dead, we may very well conclude, that the said *Animalcula* in the *Semen masculinum* of a ram being admitted into that part of the *Uterus* of the ewe, called the *Tuba fallopiana*, will live much longer, that being the place nature has provided for them; whence it may follow, that after the copulation of the male and female, the *Animalcula* may be two or three days in coming to that part of the *Uterus*, where they receive their nourishment, and consequently before the female is impregnated; and the same may be applied to other animals.

An Account of a lunar Rainbow *seen in* Derbyshire; *and a Storm of* Thunder *and* Lightning, *and a* Meteor *seen in* Yorkshire; *by Mr.* Ralph Thoresby. Phil. Trans. N° 331. p. 320.

A Certain gentleman informed Mr. *Thoresby* he had seen a lunar rain-bow on *Christmas* 1710, walking towards *Patterton-green* in *Derbyshire*, about eight in the evening; the moon had then passed her full about 24 hours; the evening had been rainy, but the clouds were dispersed, and the moon shone pretty

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pretty clear: This *Iris* was more remarkable than that Dr. *Plot* obſerved at *Oxford*, the 23d of *November* 1675, that being only of a white colour, but this had all the colours of the ſolar *Iris*, exceeding beautiful and diſtinct, only faint, in compariſon of thoſe we ſee in the day time; as muſt neceſſarily be the caſe, both from the different beams that cauſe it, and the diſpoſition of the medium: What puzzled him moſt was the largeneſs of the bow, which was not ſo much leſs than that of the ſun, as the different dimenſions of their bodies, and their reſpective diſtances from the earth, would ſeem to require; but as to its entireneſs, and the beauty of its colours, it was ſurpriſing: It continued about 10 minutes, before the interpoſition of a cloud hindered his farther obſervation.

On the 12th of *December* 1710 in the morning, there was a great ſtorm of thunder and lightning near *Leeds* in *Yorkſhire*; the lightning was ſo ſevere, that one *Sainor* a gardener, as he was riding over *Bramham-moor*, thought his hair had been burnt, and his face ſcorched by one flaſh, which being fiercer than the reſt, actually ſet on fire the ſtick he had in his hand.

A ſtrange meteor was ſeen at *Leeds* on *Holy-thurſday* 1710, which the common people called a *Flaming-ſword*; it was ſeen not only in the neighbouring towns, but a great way north, as alſo upwards of 50 miles ſouth of *Leeds*: It appeared there at ¼ paſt 10 o'clock at night, and took its courſe from ſouth to north; it was broad at one end, and ſmall at the other, and thought by ſome to reſemble a trumpet, it moved with the broad end foremoſt; the light was ſo ſudden and bright, that people were ſtartled to ſee their own ſhadows, when there was neither moon nor ſun.

It was very remarkable, that every one that ſaw it (tho' at ſeveral miles diſtance from each other) thought it fell within three or four furlongs of them, and that it went out with bright ſparklings at the ſmall end: It was likewiſe ſeen in the counties of *Nottingham* and *Derby*, as well as thoſe of *York* and *Lancaſter*.

An Account of an ancient teſſelated, or Moſaic-work, *at* Leiceſter; *by Mr.* Samuel Carte. Phil. Tranſ. N° 331. p. 334.

THIS teſſellated work, is generally called *Actæon* by ſuch Authors as mention it; but it plainly appears to be a repreſentation of the fable, which ſays, that a perſon having found fault with *Venus*, ſhe to be revenged of him, engaged her ſon

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Cupid to make him fall in love with a monſter; it was diſcover'd at about a yard and a half deep, in digging for a cellar: What extent the whole pavement was of, is not known; but this figure is an octagon, ſurrounded by a liſt, without which, tho' not repreſented in the figure, is a twiſt or wreath of various colours, and round that, a ſecond liſt like the former; theſe two liſts with, the wreath between them, are ſix inches and $\frac{1}{4}$ broad; the perpendicular and tranſverſe diameters of the area are juſt a yard; but the other from one angle to the other, a yard, two inches and a half; the man from head to foot is two foot, four inches and a half; *Cupid* ſeems to be two foot, but his feet, as well as the lower part of the monſter are wanting, the *Teſſellæ* repreſenting them being gone; the whole area of the figure which is here left blank, ſhould be filled up with white *Teſſellæ*, in like manner, as is ſeen in ſome intervals of the figures. Pl. XI. Fig. 6.

An Account of Dr. Hook's *Experiment, concerning two* Liquors, *which when mixed together, will poſſeſs leſs Space, than when ſeparate; together with another Expement confirming the ſame; by Mr.* Francis Hauksbee. Phil. Tranſ. N° 331. p. 325.

TWO liquors mixed together, and poſſeſſing leſs ſpace, than when ſeparate, Dr. *Hook* calls a penetration of dimenſions; and adds, that this penetration is the cauſe of heat, fire, flame, and the power of heat, fire and gun-powder, and ſeveral other ſurpriſing *Phænomena* in nature.

Mr. *Hauksbee* procured a bolt-head (ſuch as Dr. *Hook* deſcribes) with a long ſmall ſtem, which he filled nearly full of common water; the ſtem was marked into ſeveral diviſions, on a piece of paper paſted thereon; by which means he carefully obſerved the height of the ſurface of the water; then pouring as much out of it, as filled a certain meaſure, and throwing that away, he filled the ſame meaſure, as nicely as poſſible, to the ſame height, with oil of vitriol; which he returned into the bolt-head, in the room of ſo much water: Upon mixing theſe liquors, there enſued a pretty ſtrong ebullition, and a great many particles of air viſibly eſcaped, and the ſurface was not ſo high in the ſtem by a good deal, as when filled with water only; and then two or three drops of oil were accidentally ſpilt in putting it into the bolt-head, yet the experiment was very manifeſt, in the gradual decreaſe of the dimenſions of the liquors; and it is to be obſerved, that tho' they became very warm, yet contrary to the nature of moſt liquors in ſuch a ſtate, they continued to poſſeſs a leſs

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and leſs ſpace, which was viſible by the ſinking of the ſurface in the ſtem of the bolt-head; and in about half an hour's time, it had deſcended above an inch; and upon viewing it four days after, he found it had ſubſided at leaſt two inches below the mark he had left it at: Now, whether the ebullition produced by the heat, might not cauſe the evaporation of that quantity, it ſeemed to loſe in ſpace; or whether in ſo many hours, there might not be ſuch an evaporation of the parts of the fluid, as to become equal in bulk to the quantity of the diſpoſſeſſed ſpace, Mr. *Hauksbee* ſatisfied himſelf in the following manner: Into an upright glaſs, that held about three ounces of water, he put a quantity of the ſame fluid, equal to 885 grains, into another glaſs of the ſame form, but ſmaller, he put a quantity of oil of vitriol, equal to 456 grains; which with their reſpective glaſſes, he weighed in a nice ballance; afterwards he put the oil of vitriol glaſs and all, into that which held the water, and immediately a very great ebullition aroſe; and the glaſs that contained them, became ſo hot, that the hand could but juſt ſuffer it; he found that in two minutes, it had loſt about two grains of its weight; and that in an hour or better, it had decreaſed to ſix grains and a half; by that time the ebullition entirely ceaſed, it being then nearly reduced to the temperature of the external air: Afterwards he weighed them at ſeveral times, but found them in the ſame ſtate, as to their weight, as above mentioned; he continued them in the ſcale till the next morning, when likewiſe he could diſtinguiſh no manner of alteration in the ſaid weight: Whence it plainly appears, that the decreaſe of bulk, upon mixing theſe liquors, does not entirely proceed from an evaporation of their parts, ſince by the laſt experiment, the evaporation continued no longer than the fermentation laſted; but the decreaſe of the bulk of the bodies does not ſeem to be performed all at once, or in ſo ſhort a time as may be taken notice of in the firſt experiment.

An Experiment to produce Light *thro' a metallic Body, under the Circumſtances of a* Vacuum *and Attrition; by the Same.* Phil. Tranſ. N° 331. p. 328.

MR. *Hauksbee* cauſed a glaſs hemiſphere to be made very ſtrong, to which he procured another of burniſhed braſs, made ſo as to fall exactly with its brim about an inch within the glaſs, that he might the better cement them together, which he did ſo as to prevent any ingreſs of the air in that part; and thus when joined, they became nearly a globe, only its diameter thro' the axis, was ſomewhat more than its tranſverſe diameter, which

which was a disadvantage to its strength: In this manner he exhausted all its air, at least nearly so, and then put it on the machine to give it a circular motion, as usual in such experiments; he applied his hand to the brass hemisphere in motion, but no light could be discovered within; he then rubbed it with a fit stick, but the success was the same; afterwards he applied a piece of sealing-wax, which has a very electrical quality; this wax rubbing roughly on the brass seemed to shake its parts; yet there did not appear the least glimpse of light; he then held the flame of a candle to the brass in motion, which warmed something more than a circle thereon; yet notwithstanding a smart attrition was made on that part, all was to no purpose. Again, at night having exhausted the globe of its air, he began the attrition with a coal-cinder; which being somewhat rough, he thought might shake the parts of the metal, and put them into such a state, as to exhibit an appearance of light; but this and whatever else he then tried, was to no purpose: Having left the globe in this exhausted state on the engine, in about an hour after the glass hemisphere was broken all to pieces. From these experiments Mr. *Hauksbee* concludes, that if there be any such quality as light to be excited from a brass body, under the said circumstances, all the attritions of the several bodies used for that purpose, have been too weak to produce it; and indeed, considering the closeness of the parts of the metal, and with what firmness they adhere, intangle, or attract each other, a small degree of attrition is not sufficient to put their parts into such a motion, as to produce an electrical quality, which under the above-mentioned circumstances, he takes to be the appearance of light in such a medium.

An Account of a new Island, *raised from the Bottom of the Sea, in the Bay of* Santerini, *in the* Archipelago; *by F.* Goree. Phil. Trans. N° 332. p. 354.

AMONG the prodigies of nature, we may very justly reckon an island which arose from the bottom of the sea, in the bay, that forms the harbour of *Santerini* in the *Archipelago*; especially if we consider the situation, manner, and all the other circumstances of the formation of this new island; for what can be more surprising than to see fire not only break out of the bowels of the earth, but also to make itself a passage thro' the waters of the sea, without being extinguish'd? Or what can be more extraordinary, or foreign to our common notions of things, than to see the bottom of the sea rise up into a mountain above

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above the water, and become so firm an island, as to be able to resist the violence of the greatest storms? And tho' subterraneous fires, when pent in a narrow passage, may raise up a mass of earth, as big as an island; yet that this should be done in so regular a manner, that the water of the sea cannot any ways penetrate into, nor extinguish them; that the fire itself, after having made so many vent-holes and passages, should notwithstanding retain a force sufficient to raise up so large a mass; and in fine, that after the fire is extinct, this mass should not fall, nor sink down again by its own gravity, but still retain the same height the fire had raised it to; this is what seems to F. *Goree* more surprising than any thing, that has been related of Mount *Gibel*, *Vesuvius*, or any other vulcano: Yet this is not the first time, that these prodigies have been seen at *Santerini*; for if it be not true, that this island itself, which was anciently called *Thera*, was in like manner raised out of the sea (as *Pliny* assures us it was) it is at least most certain, that three other small islands (two of which lie within the bay of *Santerini*, and the third a little without it) have been formed, and raised up above the sea by subterraneous fires: The first of these islands, which was anciently called *Hiera*, because it was, as is supposed dedicated to *Pluto* is now called *Megali Kammeni*, that is, *the great burnt island*. *Justin* lib. 30. c. 4. speaking of the first war of the *Romans* with the *Macedonians*, and of the two months truce, which *Philip* king of *Macedon*, and father of *Perses*, then demanded, and which he obtained, according to *Salianus*, the 4th year of the 145th Olympiad, and the 196th year before the birth of our Lord, tells us, that this island rose up from the bottom of the sea this very year after an earthquake; his words are these, *Eodem anno inter insulas Theramenem et Therasiam, medio utriusque ripæ, & maris spatio, terræ motus fuit, in quo, cum admiratione navigantium, repente ex profundo cum calidis aquis insula emersit*: It became half as big again in the year of our Lord 726, by the joining of another island thereto; which according to *Theophanes* a *Greek* author, cited by *Baronius*, also rose out of the sea, and raised itself exactly to the same height, with the island *Hiera*, and united so well to it, that at this time there remains no other mark of its joining, than only a cleft or fissure, which reaches from one end of the island to the other, and in several places is not half a foot broad. The same thing happened a second time in the year 1457, as appears by a *Latin* inscription on a marble at *Santerini*; but with this difference, that the subterraneous fire, after having raised to the height of five or six foot above the water, a vast

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vaſt quantity of rocks, which formed a ſpace about a mile in circumference, opened a paſſage for the ſea-water to enter, whereby it was extinguiſhed; and the middle of that ſpace remained ſo low, that the ſea flowing into it by a ſubterraneous canal, formed there a ſmall lake, which continues to this day. As to the ſecond iſland, which is a little without the bay, and called in *Greek*, *Aſproniſi* or the *white Iſland*, becauſe the earth with which it is covered, is white like lime; *Pliny*, who lived in the time of the emperor *Veſpaſian*, ſays, that it roſe out of the ſea, and appeared in his time. The third iſland, which is the leaſt, and called by the *Greeks*, *Mikri Kammeni*, or the *leſſer burnt Iſland*, was formed in the year 1573, according to the account of ſeveral old people, who had learned it of their anceſtors; and it is between this iſland and the *Great Kammeni*, that on the 23d of *May*, N. S. in the year 1707, at break of day, another new iſland was firſt diſcovered: Five days before it appeared, *viz.* on the 18th of *May*, between one and two o'clock in the afternoon, there was an earthquake at *Santerini*, which was not violent, and continued but a moment; and in the night, between the 22d and 23d, there was another, which was ſtill leſs ſenſible than the former: It is natural to ſuppoſe, that it was then the new iſland firſt began to move, and raiſe itſelf from the bottom of the ſea; yet if we conſider, that theſe two earthquakes were not violent, and laſted but a moment; and that the ſea was in this place from 80 to 100 fathoms deep, it ſeems difficult to believe, that in five days time it could riſe to this height; what inclines F. *Goree* to think the contrary, is that its height then above the ſurface of the ſea, and which it did not arrive to in leſs than three years time, was much leſs than that from the bottom of the ſea to the ſurface of the water; add to this, that a long time before theſe earthquakes, the fiſhermen perceived a ſtench every time they paſſed by that place, which ſhews that the iſland had then begun to move; yet it is very certain, that there were not any other earthquakes at *Santerini* than thoſe, which 14 or 15 years before, continued for ſeveral days, and were very violent: However it was, ſome ſeamen diſcovered this iſland early in the morning; but not being able to diſtinguiſh what it was, went immediately to it; but returned as haſtily back again, and ſpread the report over the iſland; which was the more readily credited, becauſe all the inhabitants knew, and ſeveral of them had themſelves ſeen, what happened in the year 1650; there was then a new iſland, like this, which roſe up between the iſlands of *Santerini*, *Nio* and *Andro*, by means of ſubterraneous fires; which cauſed ſeveral violent

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violent earthquakes, accompanied with a roaring noiſe under ground, ſulphureous exhalations, an inſupportable ſtench, and black ſmoke, which roſe out of the ſea with flames to the height of 10 or 12 cubits; the ſea was then toſſed backwards and forwards in ſuch a manner by the terrible ſhocks of the earth, that it overflowed and deſtroyed 30000 perches of land in *Santerini*; and the air was ſo infected with exhalations, from the fire, that 25 perſons and a great many beaſts were ſtifled; at length, when this iſland had not above eight or ten fathoms of water to riſe, ſo as to appear above the ſurface of the ſea, the force of the ſubterraneous fire was ſo violent, as to open a paſſage before its time; whereby the water of the ſea, entering in like a torrent, extinguiſhed the fire, and this maſs of earth and ſtones did not riſe any higher: How great ſoever the apprehenſion of the inhabitants of *Santerini* was at the firſt ſight of this new iſland, yet a few days after, not ſeeing any appearance either of fire or ſmoke, ſome of them took a reſolution to go and view its ſituation, which they did accordingly, and went on ſhore upon it; they paſſed from one rock to another, on which they met with ſeveral very remarkable curioſities; and among the reſt, a ſort of white ſtone, that cut like bread, and reſembled it ſo well in form, colour, and conſiſtence, that were it not for its taſte, any one would take it for real bread; there was alſo a great quantity of freſh oiſters, which they found ſticking to the rocks; while they were buſy about this, they perceived the iſland move and ſhake under their feet: In ſhort, the riſing of the iſland was viſible to the eye, and it increaſed not only in height, but alſo in length and breadth; tho' it was already between 15 and 20 foot high above the ſea, it could not yet be ſeen from the mountain *Merovigli*, or the caſtle of *Scaro*, which ſtands upon the ſhore, by reaſon the *Leſſer Kammeni* lay between, and hindered the ſight; but 15 days after, they began to ſee it from *Merovigli*, and in a few days after that, from the caſtle of *Scaro*, ſituated upon another mountain; whence we may judge how much this new iſland grew in a few days: As the motion, by which this iſland increaſed every day in height was ſometimes equal, and at other times unequal, in reſpect to all the parts of ſo large a maſs, ſo it did not always riſe equally on every ſide; it often happened that while it grew in height, and length on one ſide, it ſunk down, and decreaſed on the other: One day F. *Goree* ſaw a rock riſe out of the ſea, at 40 or 50 paces diſtant from the iſland, which he continued to obſerve for four days together; at the end of

which it ſunk again into the ſea, and did not appear any more; but this was different from what happened to ſome others, which having diſappeared, as this did, re-appeared again ſome time after. The *Leſſer Kammeni*, which lies very near, was often ſhaken with the motion, which raiſed this new iſland; from a ſmall cleft, obſerved on the top of this little iſland, ſometimes ſtones would break looſe, which rolling down its ſides into the ſea, would raiſe a cloud of duſt, like ſmoke: At this time the ſea, within the gulph or bay of *Santerini*, changed its colour ſeveral times; at firſt it appeared green, afterwards reddiſh, and ſome time after of a yellowiſh colour, with a ſtench, which ſpreading itſelf over great part of *Santerini*, gave reaſon to think that this colour was only owing to the ſulphur, with which the ſea was covered: The ſmoke appeared firſt on the 16th of *July*, at which time, from a place in the ſea, where they aſſured F. *Goree*, they could never before find any bottom, and which was upwards of 60 paces diſtant from the new iſland (which they then called the *White iſland*) there aroſe a ridge of black ſtones, which the *Greeks*, by reaſon of their hardneſs, call *Sideropetres*, or iron ſtones, forming another iſland, called by the inhabitants the *Black iſland*, and which was afterwards not only the center of the whole iſland, but alſo of the fire, ſmoke, and great noiſe that was heard ſome time after: The ſmoke that iſſued out of this ridge of ſtones, or *Black iſland*, was very thick and white, as if it had proceeded from five or ſix lime-kilns joined together, and being carried by a north wind towards the caſtle of *Acrotiri*, it went into the houſes of the inhabitants, but without cauſing any great annoyance, becauſe it had no very bad ſtench; four days after the ſmoke had thus appeared, they ſaw in the night time fire iſſuing out from the ſame place: The inhabitants of *Santerini*, and eſpecially thoſe of the caſtle of *Scaro* began to be apprehenſive, having fire and ſmoke continually before their eyes; yet the fire was then but very little, not being above the breadth of the mouth of a furnace, and did not appear in the day time, only in the night from ſun ſetting to ſun riſing; and was ſo far from ſpreading the whole length of the ridge of ſtones above-mentioned, that it poſſeſſed but one ſmall part of it, which was always after that the common paſſage for the ſmoke and fire: As to the firſt, or *White iſland*, neither fire nor ſmoke were to be ſeen, yet it continued to grow larger; but the *Black iſland* increaſed much faſter: Huge rocks were ſeen daily to riſe on every ſide of it, which made it ſometimes longer, and at other times broader;

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and by their height could be very nearly judged the number of feet it roſe every day, or night; ſometimes theſe rocks joined themſelves to the iſland, and at other times they were at a diſtance from it; ſo that in leſs than a month, there were four little *Black iſlands*, which in a few days after united together, and formed but one iſland: As the ſmoke increaſed very much, and there was no wind ſtirring, it roſe up to the middle region of the air, ſo as to be ſeen at *Candia*, *Naxos*, and other iſlands, and in the night time it appeared all of a flame 15 or 20 foot high; the ſea at that time was covered with a matter, or froth, which in ſome places was reddiſh, and in others yellowiſh, from whence there proceeded ſo great a ſtench over the whole iſland of *Santerini*, that for fear of being infected, ſeveral perſons were obliged to burn incenſe, and others to make fires on the tops of their houſes, to diſperſe it, and purify the air; but it did not continue above a day and a half; for a ſtrong ſouth-weſt wind aroſe, which together with the motion of the ſea, did indeed diſperſe this frothy matter, but occaſioned otherways great damage to the beſt part of the iſland of *Santerini*: At that time they were in great hopes of having a very plentiful vintage, when this wind carried all the ſmoke upon their vineyards, which burnt them up in ſuch a manner, that the grapes, which were not yet ripe, became in a night's time like dried raiſins; ſo that they were afterwards obliged to throw them away, becauſe of their ſourneſs: Nor was this the only effect occaſioned by this thick ſmoke; for it is farther remarkable that ſilver and copper were thereby turned black; and tho' ſome people, who were obliged to paſs thro' the ſmoke, in going to their houſes, aſſured F. *Goree*, that it had no very bad ſtench, yet ſeveral of them were, that and the next day after, troubled with great pains in their heads: At this time the *White iſland*, which ſeemed to be above the *Leſſer Kammeni*, and could be ſeen from the firſt floor of the houſes in the caſtle of *Scaro*, ſunk down ſo low, that it could not be ſeen from the ſecond: Hitherto the ſea had not been obſerved to boil up, nor was there any noiſe heard upon the *Black iſland*; but on the 31ſt of *July*, the ſea was ſeen to emit ſmoke at two ſeveral places, one of which was about 30, and the other upwards of 60 paces diſtant from the iſland; in theſe two places, both of which were perfectly round, the water of the ſea looked like oil, and ſeemed to riſe up, and bubble, which it continued to do for more than a month; in which time there were a great many fiſh found dead on the ſhore, by their happening to have been too near theſe two

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places: The following night there was heard a dull hollow noiſe, much like that of ſeveral cannons fired at a diſtance; and at the ſame time there was ſeen to ariſe out of the middle of the funnel, flames of fire, which darted very high into the air, and diſappeared immediately; next day there were ſeveral repetitions of the ſame noiſe, followed by a ſmoke, not white as uſual, but blackiſh; and which notwithſtanding a very freſh north-wind, roſe up in a moment to a prodigious height, in form of a column; and would in the night time, in all probability, have appeared, as if it were all on fire: *Auguſt* 7th the noiſe altered, and from being dull as before, became very loud, and reſembled that made by ſeveral large ſtones thrown all together into a very deep well; and F. *Goree* ſuppoſes, that this noiſe was occaſioned by ſeveral huge pieces of rock, which after having been raiſed up with the iſland by the violence of the fire, broke off by their weight, and fell back again into the ſubterraneous caverns; what confirmed him in this opinion was, that he ſaw at that time the ends of this iſland in ſo great commotion, that after appearing for ſome days, they then diſappeared, and after that re-appeared again; however it was, this noiſe, after having continued ſo for near a month, was ſucceeded by another much louder, and more extraordinary; it ſo nearly reſembled thunder, that when it really thundered, as it did three or four times, there was very little difference between the one and the other: As the paſſage, which the fire had made itſelf by its violence thro' ſo many rocks, was not probably, in a ſtreight line, and in ſome places narrower, in others larger, and more free; ſo it is probable, that the fire, or rather the ſulphureous and burning exhalations, cauſed this great noiſe, by turning from one ſide to the other, in theſe winding caverns, and endeavouring to get a paſſage out, which was difficult for them to find; and this is the reaſon why the noiſe of this ſubterraneous thunder was ſometimes not ſo loud, and why a little after it grew more violent, and ſometimes ſo ſtunning, that people could ſcarce hear each other ſpeak; and why the *Black iſland* which was already very high, ſeemed to crack on every ſide; and in ſhort, why the impriſoned fire, after ſeveral windings and turnings, having collected all its force, was enabled to break out with a noiſe, equal to that of ſeveral cannons diſcharged at once. *Auguſt* 21ſt, the ſmoke diminiſhed conſiderably, as alſo the fire, none appearing in the night time; but next day both returned with greater violence than any time before; the ſmoke was reddiſh, and very thick, and the fire ſo great, that the water of the ſea ſmoaked, and bubbled up all around

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around the *Black iſland*: In the night F. *Goree* viewed with a teleſcope the great fire that appeared upon the mountain of this iſland, and he reckoned 60 openings, or funnels, divided from each other by rocks, all which emitted a very bright flame; probably there were others, and perhaps, as many on the other ſide of the mountain, which he could not ſee; next morning he obſerved, that the iſland had been very much raiſed in the night time; that a range of rocks, about 50 foot long, had roſe out of the water, which made the iſland broader than it was before; and that the ſea was almoſt covered over with the reddiſh frothy matter, above-mentioned; this matter, or froth appeared on the ſea every time that the iſland increaſed conſiderably, and occaſioned a ſtench, much like that of the ſink of a ſhip; which we may ſuppoſe to ariſe from a ſlimy earth, mixed with ſulphur, which being raiſed up with the rocks, and coming to be waſhed off by the waves, was looſened, and diluted by the water, and ſo ſent up to the ſurface the ſalts with which it was impregnated: Hitherto the fire had only appeared in one place, on the top of the *Black iſland*; but on the 5th of *September* it made itſelf another paſſage, and appeared at the extremity of that iſland, on the ſide next *Teraſia*, another iſland, that ſome authors affirm to have been formerly joined to that of *Santerini*, and ſeparated therefrom by an earthquake: The fire did not continue at this end but a few days, during which it decreaſed at the place from whence it commonly uſed to iſſue out; and here we were agreeably ſurpriſed to ſee the fire dart out three ſeveral times from this place without any noiſe, and riſe up in the air like a large rocket; the following days there was much the ſame appearance; for the ſubterraneous thunder, after having made a great noiſe, broke out from time to time with a clap as loud as that of a cannon, and was accompanied with a very beautiful and large flame, which ſhooting up in an inſtant to a great height, fell down on the iſland again, illuminating it almoſt all over: The figure it made in the air very much reſembled a certain artificial fire work, in *France* called the *Gerbe*; but yet with this difference, that the former roſe much higher, and was much larger, but not ſo diſtinct as that of the *Gerbe*; immediately after, there appeared in the air a blaze, in the ſhape of a long fiery ſword, which continued ſometime, without moving, over the caſtle of *Scaro*, and afterwards diſappeared: At that time alſo, the *White* and *Black iſlands*, having increaſed in length, in proportion as they roſe in height, united together; and the end of the *Black iſland* towards the ſouth eaſt, did not

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increaſe any more, either in height or length, whilſt that towards the weſt increaſed very ſenſibly to the ſight; which made F. *Goree* imagine, that the mine of ſulphur being at this place, and the fire not finding any paſſage out here, had force to raiſe up this part, and not the other; for in the middle of the iſland it always found openings to iſſue out at, together with the ſmoke; where it then had four paſſages, ſo near each other, that one could not well diſtinguiſh them but by the ſmoke, not that which commonly iſſued out, and was continual, but that which roſe up at ſome certain times with a great force; for this ſmoke came forth ſometimes at one paſſage, and ſometimes from another, and oftentimes out of the whole four together; ſometimes with a great noiſe, and at other times without any noiſe at all, tho' then it alſo iſſued out with the ſame impetuoſity; there likewiſe came out of theſe paſſages a whiſtling noiſe, like that of an organ pipe, with a variety of ſounds: One would think, that the noiſe of this thunder ſhould not then be ſo loud, by reaſon of the ſeveral paſſages above-mentioned; yet notwithſtanding it was not at any time ſo great, and ſo frequent, as it was then, and as it was upwards of ſix months after, when it was like the report of a cannon; and not a day or night paſſed, but 5 or 6, ſometimes 10 or 12 of them were heard, and at the ſame time ſeveral large burning ſtones were thrown into the air; ſome of which falling on the *Great Kammeni*, ſet fire to ſome thickets, and others were caſt upwards of a mile into the ſea; theſe claps were always attended with the ſmoke already mentioned, very different from that which continually iſſued out from the gulph of fire almoſt in the middle of the iſland; for this latter was much thicker and blacker, and roſe in an inſtant much higher, and was not diſperſed till ſome time after, and then fell in aſhes upon the country, or into the ſea; ſome of which the wind ſometimes carried as far as *Anacuphi*, an iſland about 25 miles diſtant from the bay of *Santerini*: Some of theſe aſhes, which were of a colour between black and white, were put into the fire, imagining they would burn like gun-powder, which they very much reſembled; but they produced no other effect than making a ſmall hiſſing noiſe. *September* 18, two hours after midnight there was an earthquake felt at *Santerini*, tho' the ſubterraneous fires had had a free paſſage for ſo long a time; it did not do any damage, and had no other effect than enlarging the iſland very much, and removing for ſome days the fire, and ſmoke into other places, thro' new vents it made itſelf, increaſing both of them

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them very considerably; and indeed, F. *Goree* never saw so much fire, nor heard such terrible claps, as after this earthquake; by the violence of these claps, houses were shaken at upwards of three miles distance; and out of the middle of a great smoke, which rose up and appeared like a mountain, one might see and hear huge pieces of rock fall down into the sea, and upon the island, thrown out with the same violence, and noise, as a bullet out of the mouth of a cannon. The *Lesser Kammeni* was several times quite covered with large stones, crusted over with burning sulphur; several of which rolling afterwards from the top of this little island into the sea, made a very bright light, and afforded a pleasant prospect in the night; at first F. *Goree* thought, that the fire had passed under-ground from the new island to this, because they are not far asunder; but he soon found his error, and that this fire proceeded only from these stones sulphured over; for the sulphur with which they were crusted over, being consumed, they were all extinguished in half a quarter of an hour, excepting some few that continued shining upwards of half an hour: One day when the *Lesser Kammeni* was all on fire, after one of these furious claps, and the air was so likewise, thro' the frequent flashes of fire that appeared in the clouds, three flashes were seen come out of the places where the fire was, which one could not distinguish from real lightning, but that they were formed lower, and at the two ends of the island; by the violence of one of these claps, part of the top of the new island was carried off into the sea, and several stones thrown upwards of two miles; and as if the mine had been exhausted by this great clap, three or four days passed without any noise, and almost without any fire, or smoke: But the fire soon kindled again, and the island became more terrible than before; F. *Goree* was then at a village six miles off, where (notwithstanding it lay under a mountain) the explosion of the mine was distinctly heard; the castle of *Scaro* suffered so violent a shock, that the doors and windows that were shut, were opened by the force and violence of the clap. *February* 10th, 1708, at half an hour after eight in the morning, there was another earthquake at *Santerini*, and some persons assured him, that there had been another the night before, but not so sensible as this; and the vulcano was then so far from being exhausted, that it acquired new force by other veins of sulphur, which took fire at a greater distance; as appeared from the fire and flames, which arose so frequently into the air, and fell again all over the island, affording in the night-time as fine a sight as any artificial fire-works; besides

ſides this, ſeveral large rocks joining to the iſland, which before were even with the water, were now raiſed much higher; and the noiſe, ſmoke, and boiling of the ſea increaſed much; the ſubterraneous noiſe was more violent than ever, and continued ſeveral days together without any intermiſſion; and in a quarter of an hour the mine diſcharged itſelf five or ſix times; the noiſe of which, with the large quantity of ſtones it threw into the air, the ſhocks it gave the houſes, and the fire which appeared in open day-light (which was never ſeen before) very much ſurpaſſed all that had hitherto happened. The 15th of *April* was the moſt remarkable both for the great number, and violence of the claps; by one of which near 100 large ſtones were thrown up all at once into the air, which fell again at about two miles diſtance into the ſea; tho' F. *Goree* was then about three miles off from the new iſland, he obſerved a ſtone of a ſurpriſing bigneſs, which did not riſe ſo high as the reſt, but was driven farther in a ſtreight line, like a cannon ball. From the 15th of *April* to the 23d of *May*, (which was a year from the production of this new iſland) nothing in particular was obſerved, only that the iſland increaſed in height, and not in length; and that one furious clap beat down at once all its top, which, by the aſhes and ſtones of all ſizes, that fell upon it both day and night, became much higher than it was before; after this every thing began to abate, the ſmoke decreaſed, the ſubterraneous noiſe was not ſo violent; and the claps tho' very frequent, were not however, ſo loud, becauſe the funnels, which gave vent to the fire and ſmoke, were then much larger than they were before. Hitherto F. *Goree* had viewed this iſland only at a diſtance; but ſeeing that there was then no danger, he went in company with F. *Criſpo*, the *Latin* biſhop of *Santerini*; and in going directly to it, they were obliged to paſs over a place, where the ſea ſmoaked very much, but did not bubble; where they were no ſooner come than they perceived a heat ſtrike upon their faces, which was no other than the fumes of the ſulphur; upon putting their hands into the water, they felt it very hot; they were then 500 paces off from the new iſland; from whence they went directly over to that part of the iſland, where it had increaſed in length; but ſeeing the ſmoke was very thick, which ſhewed that there was a great fire all thereabouts, they did not think it ſafe to go any nearer, and ſo ſatisfied themſelves with viewing only the ſpace that was between this new iſland, and the *Leſſer Kammeni*, thro' the narroweſt part of which they judged a galley might paſs; after this they went aſhore on the *Great Kammeni*, from

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from thence to view the whole burning iſland nearer, and without danger, eſpecially, that ſide of it which was ſcarcely ſeen from the caſtle of *Scaro*; from hence it was, that after having well examined every particular, they judged this new iſland to be about 200 foot in height, five miles in circumference, and a mile over at its broadeſt part; as to its form, it is oblong, and reſembles in ſome meaſure the figure of a dragon. After having tarried ſome time upon the *Great Kammeni* (where they often ſaw at no great diſtance, a great many ſtones thrown violently out of the gulph of fire, and fall down again with a terrible noiſe upon the iſland) they reſolved to coaſt it round, and go to the other end of it, where the iſland had not increaſed for ſeveral months, and where there did not appear any fire or ſmoke; they were within 100 paces of it, when putting their hands into the water, they perceived it warm, and that the farther they went the hotter it grew; at this inſtant the mine diſcharged itſelf, and the wind drove upon them the thick ſmoke, which broke out with great violence every time the mine took fire, and a ſhower of aſhes, and ſmall ſtones, no bigger than little hail ſtones, falling upon them, they were obliged to quit their deſign of going on ſhore on the iſland at this place; this ſhower of aſhes, and ſtones being over, they retired a little, by reaſon of the great heat of the water; and letting down a plummet, they had at this place 95 fathoms of water, without finding the bottom, the line not being long enough; afterwards viewing the ſpace at this end between the iſland, and the *Leſſer Kammeni*, they found in ſeveral places that it was narrower at this ſide, than at the other; and that if the new iſland ſhould continue to grow bigger, ſeveral rocks, which were already half above the water, and roſe up nearer to the *Leſſer Kammeni*, would in time ſhut up the paſſage, and join both the iſlands together, ſo as to make a little port between them, which would be very commodious for the ſhipping of *Santerini*: Afterwards returning to the caſtle of *Scaro*, they paſſed by the little port of the *Leſſer Kammeni*, and notwithſtanding its nearneſs, the inhabitants could not hear any of the noiſe that this new iſland made, which was owing to its height: During the reſt of the time that F. *Goree* tarried at *Santerini*, to the 15th of *Auguſt* 1708 (at which time he came away) the ſmoke, fire, noiſe, &c. continued much the ſame as has been now deſcribed, that is, always pretty moderate. From his leaving *Santerini* to the 6th of *July* 1711, F. *Goree* received ſeveral letters, and ſaw and ſpoke with ſeveral perſons who came from thence; and they all told him, that the new

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iſland ſtill grew in length, on that ſide next *Teraſia*; that then it was about ſix miles in circumference; that as to the fire, and noiſe under ground, they were more moderate than before: F. *Goree* conſidering, that the paſſages which give vent to the fire are very large, and almoſt in the middle of the iſland; and that there is no appearance that the fire will ever make a paſſage at the bottom of the ſea, ſo as to let the water in to extinguiſh it, ſuppoſes that this phænomenon will not have an end, till the mine of ſulphur be entirely conſumed.

An Experiment ſhewing the Direction *of a drop of Oil of* Oranges *between two glaſs Planes, towards any ſide of them that is neareſt preſſed together; by Mr.* Francis Hauksbee. Phil. Tranſ. N° 332. p. 395.

THE glaſs planes Mr. *Hauksbee* uſed were about ſix inches ſquare, and being very clean, a drop or two of oil of oranges was let fall on the lower plane, ſuppoſe at B Plate XII. Fig. 1. then the upper plane was laid on it, ſo near as to touch the liquid, that it might become contiguous to both their ſurfaces; thus the planes being made to touch each other at the end A, remain open at the end C, the lower plane lying paralled with the horizon, the drop of oil would immediately move towards that end where the planes touched each other; and when it arrived there, it was but reverſing the angle, and the drop would return from A to C, and after the ſame manner it might be directed to any ſide, or part of the ſame: Moreover, if the planes were elevated eight or ten degrees at A, yet would the drop aſcend towards the ſide A, tho' not ſo ſwift, as when the planes were in the above-mentioned poſition: It was farther to be obſerved, that the nearer the drop approached the ſides in contact, the velocity of its motion would be proportionably increaſed; the reaſon of which ſeems very plain; allowing the aſcent of water in ſmall tubes, and between the ſurfaces of nearly contiguous planes, to be explained from the force of attraction, that one ſurface has to another at ſuch a diſtance; for the drop of oil, moving on towards the contiguous ſurfaces, comes to enlarge its ſpace, and touch the planes in a greater number of parts, as it approaches nearer and nearer the ends in contact; thus in the whole progreſs of its motion, it is continually increaſing in its ſurface, and conſequently the force of attraction muſt increaſe in proportion to that ſurface; ſo that the velocity of its motion muſt neceſſarily be augmented: This experiment ſeems very ſtrongly to confirm thoſe formerly made on the ſame ſubject,

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ſubject, from the gradual increaſe of the motion of the drop; thereby repreſenting the ſeveral appearances of the aſcent of water in different ſized tubes, or between planes whoſe ſurfaces are placed at different diſtances; the ſlower motion repreſenting thoſe experiments made in larger tubes, and the ſwifter in ſmaller ones; and the ſame thing is to be obſerved in planes at different diſtances: Mr. *Hauksbee* afterwards repeated the ſame experiment *in Vacuo*, where in all reſpects it anſwered as in the open air; which is a plain indication, that the preſence of the air has nothing at all to do in producing this phænomenon.

Obſervations on the production of Mites; *by M.* Leewenhoeck. Phil. Tranſ. N° 333. p. 498.

THOSE ſix or eight long particles on the body of the mite, and which one would call hairs, are longeſt on the upper part of the body, and twice as long as thoſe on the ſide of the ſaid animal; and upon obſerving carefully, and thro' a microſcope that magnifies much, thoſe long particles, one would be apt to judge that ſuch a long particle conſiſted of 50 parts, reſembling ſo many ſmall joints; and that again from each of theſe diviſions little hairy particles proceeded, which afforded an agreeable ſight: M. *Leewenhoeck* obſerved with great attention the aforeſaid long particles, in order to diſcover, whether there were any motion in thoſe parts, which appeared like joints; but all he could diſcover therein, was, that theſe little animals could move, or ſtir thoſe long particles, which he formerly took to be hairs, in ſuch a manner, that when they were obliged to creep thro' narrow paſſages, they could clap them cloſe to their bodies; and that each of theſe particles had but one moving joint, which was next to that part, faſtened in the ſkin: Thus we ſee the wonderful formation of that little animal, called a mite; but what ſhall we ſay of the vaſt number of ſeveral kinds, and particular forms of other *Animalcula*; ſome of which are ſo ſmall, that their whole body is not only not ſo thick as the diameter of one long particle on the body of the mite, but even not ſo big as one of the ſlender particles, on thoſe jointed parts of the long hairy particles, and which are not to be ſeen but thro' ſome of the greateſt magnifiers: In ſhort, the ſmallneſs of the parts, of which all bodies are compoſed, and ſet together is ſo very minute, as to be inconceiveable: Afterwards M. *Leewenhoeck* took ſome mites out of an earthen veſſel, wherein lay ſome flower of wheat for about 14 days; and viewing them thro' a microſcope, he could not per-

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ceive, tho' he viewed them very nicely, thoſe jointed parts, covered, as it were, with hairs, on the bodies and feet of the mites, which were themſelves ſo ſmall, as to ſeem to be nothing but hairs; and tho' he viewed ſeveral of theſe mites, he doubted whether he ever ſaw thoſe little hairs on the hairy parts but once; thoſe parts, which appeared to be hairs on the hinder part of the body, were not near ſo long as thoſe of ſome other mites he had taken out of the dried bladder of an ox; and though theſe were dead, yet he could perceive on thoſe parts that paſſed for hairs, other, and much ſmaller ones: From which obſervation he conſidered, that as flies, which we judge to be of one ſort, are notwithſtanding of very different kinds; for ſome of them lodge their eggs in fleſh, others in cheeſe, others again in dung; and accordingly, the worms that are hatched from theſe eggs, receive their food, and increaſe, from the ſeveral ſubſtances wherein they lie; ſo likewiſe among mites, there are ſome that live on fleſh, and others again on meal, or bread: For his further ſatisfaction, M. *Leewenhoeck* viewed ſome figs, thinking to find a great many mites among them, but he met with no more than three or four that were living, and theſe had longer hairs on the hinder-part of their bodies, than he had hitherto ſeen on any; and theſe again were alſo covered with as many ſmall hairs, as was ſaid above: In his ſearch after mites, he diſcovered a kind of *Animalcula*, ſmaller than the above-mentioned ones, and of a quite different figure from the other; the hairs on the body and feet were very ſhort; the body, and particularly the head, were of quite another make; for theſe had on the ſide of the head two ſhort inſtruments, whereby they made a very quick motion; whence he began to conſider, whether theſe inſtruments were not given them by nature to convey their food to their mouths, becauſe their head was ſhorter than that of a mite, which latter animal is likewiſe the biggeſt; he alſo conſidered, whether this *Animalculum* might not be the production of a very ſmall fly.

A B, Pl. XII. Fig. 2. repreſents, as it appeared thro' the microſcope, a ſmall hair of one of the above-mentioned mites, which a certain gentleman compared to an *Indian* or *Japan* cane with ſeveral joints, and ſaid it appeared to him thro' the microſcope, as if there were ſharp twigs ſprouting out from each joint: Moreover, M. *Leewenhoeck* placed before four different microſcopes a large mite, which he judged to be the female, ſtuck on the point of a ſmall pin, that he might the better view thoſe

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thoſe parts, taken for hairs; and he obſerved little joints in each of thoſe long hairy particles; and when he turned the mite a little on one ſide, he could not ſee thoſe ſmall parts any more; whence he concluded, that thoſe hairy parts were provided with two very ſmall hairs, all along oppoſite to each other; ſo that when one ſide was turned to the ſight, the other could not be ſeen: He obſerved, that one of theſe mites, after being ſtuck on the point of a pin, laid two eggs, one of which appeared to the eye like a large grey pea, and the other he judged to be like a ſparrow's egg; another mite had laid four eggs; and another, which he had newly placed before a microſcope, laid two eggs; the mite, that had laid four eggs, was faſtened only by the two hinder legs of the left ſide of her body, ſo that ſhe could move the fore-part, and even diſplace it; and he obſerved, that, after the ſaid mite had been ſtuck on the point of a ſharp pin for the ſpace of ten days, ſhe had eaten two of her eggs: M. *Leewenhoeck* opened the bodies of ſeveral of theſe mites, and took two eggs out of one of them; and at another time three out of the body of another, which were full grown; but in moſt of them he could diſcover no eggs; and ſome of them he ſuppoſed to be males; and tho' the liquid matter of the eggs, which he took out of their bodies, was evaporated in a ſhort time; yet thoſe eggs, the mites had laid, preſerved their perfect magnitude and roundneſs; the reaſon of which was, as he imagined, that the ſhells of thoſe eggs, he had taken out of their bodies, had not yet acquired their full hardneſs, and conſequently, the liquor was more eaſily evaporated: He put the above-mentioned mite, that had laid two eggs, into a box, together with a microſcope, before which it was placed; and on the 17th of *October* he put it into his pocket, to ſee what time was requiſite for hatching the young mites from the eggs; he viewed theſe eggs more than once every day; and after he had carried them nine days in his pocket, he obſerved, that the eggs, which were at firſt tranſparent, became dark at one extremity, and that that darkneſs increaſed from time to time; ſo that on the 30th of *October* he could diſcern but a very ſmall part of the egg tranſparent; and on the firſt of *November* he obſerved but one egg; and that which remained of it was ſo little, and lay ſo confuſed, that he could determine nothing with certainty; and in the ſecond egg he did not only obſerve the ſame appearances as the other, but he likewiſe ſaw an *Animalculum* lying in it, of which he could perceive the head, and

and ſome of the hairy parts of the body; and whereas, the *Animalculum*, being now compleat, did not quite fill the ſhell of the egg, ſome part of which was now tranſparent, whereby he could more plainly diſcover the *Animalculum*, and its hairs in the egg; whereupon, he reſolved to view the ſaid *Animalculum* ſeveral times that day, and in about an hour after his firſt diſcovery, he obſerved, that the *Animalculum* had forced out about a third part of its body, and was making a great motion with four of its feet; but, foraſmuch as it could not faſten its legs, which it had put out of the ſhell, upon any place, it made a great ſtir therewith for that whole day, without being able to bring its body farther out of the ſhell; but next day it was dead. Upon viewing theſe eggs, as they were placed before the microſcope with the light of a candle, he obſerved a vaſt number of exceeding ſmall lights, or tranſparencies, in the egg-ſhell, which he imagined might be owing to the unequal thickneſs of the parts of the ſaid egg-ſhell. He likewiſe obſerved, that a mite, which had been ſtuck thro' the back with the point of a needle, had an egg faſtened to the ſmalleſt part of one of its legs; and tho' it moved its foot very much, yet the egg ſtill continued to ſtick faſt thereto: Whence he concluded, that the eggs of mites are of the ſame nature with thoſe of caterpillars, and other reptiles, whoſe eggs, wherever they fall, ſtick faſt, by means of a ſlimy, or glutinous matter, wherewith they are ſurrounded; but next day he obſerved, that the mite had worked the egg off its leg, and by the help of its claws held it in one of its feet; and tho' he made a great ſtir with its legs, and particularly with that which held the egg, yet it did not let it drop, but ſhifted it from one foot into the other, which was a very agreeable ſight; but next day it was not to be found: Not being ſatisfied with the aforeſaid obſervations, he placed before two microſcopes two other mites, which he judged to be females; one of theſe had laid two eggs, and the other three; and as far as he could judge, they were about three days old; in the day-time he carried thoſe microſcopes about with him, together with the mites; and after the ſpace of ten days, he obſerved, that two of the eggs, which lay cloſe to each other, had been hatched, and that the young mites were come out of them, and the ſhells lay open; but he could not find the mites; as for the other three eggs, there came a young mite out of one of them the ſame day; and on the 12th day another came out; but it could not thruſt out its body

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body above half way, and did not live above a day; which might be owing, as M. *Leewenhoeck* imagined, to its ſticking faſt in that glutinous matter, with which the egg was ſurrounded; as to the third egg, it lay lengthways to the ſight, and he expected before three days, that the young one would have come out; computing that the *Animalculum* was arrived to its full growth in the egg, and that it had filled it both in length and breadth, there being likewiſe a tranſparency in the egg; at length, there came a little mite out of the third egg, contrary to his expectation, which, he imagined, died in the ſhell before it could get quite out: When we conſider, that the eggs of mites are laid one after the other, and that in the copulation of theſe animals, a great many of their eggs are, in all probability, impregnated at the ſame time; and moreover, that in diſſecting ſuch an *Animalculum*, its *Viſcera* cannot be exactly diſtinguiſhed, how ſmall then muſt the *Animalcula* be, that are found in its *Semen Maſculinum*: Now to compare the bigneſs of mite eggs with thoſe of a pigeon's; if we ſuppoſe one egg of a mite to be equal to the diameter of a hair of one's head (as it appeared to M. *Leewenhoeck* thro' a miſcroſcope) and 600 hairs of a man's head laid by each other to be equal to the length of an inch, and the diameter of a pidgeon's egg to be $\frac{1}{4}$ of an inch; then 450 diameters of a mite's egg are equal to one diameter of a pigeon's egg; and ſuppoſing their figures to be alike, we may affirm that 91125000 eggs of a mite are not bigger than one egg of a pigeon.

On the 10th of *November*, by means of glutinous matter, M. *Leewenhoeck* ſtuck two mites, he judged to be females, upon the point of a ſmall pin, and on the twelfth of the ſame month, he found they had laid three eggs between them; the next day there were four, and ſoon after 6; he let theſe eggs ſtand upon his deſk, to ſee how long it would be, in that cold weather, before they were hatched: On the eighth of *December* he could perceive, that one of theſe mites ſtirred three of her legs; but after that he could perceive no more ſigns of life in her: From the tenth of *November*, he viewed ſeveral times the ſaid ſix eggs, and obſerved, that at their thickeſt end (for they ſeemed to be exactly ſhaped like hen eggs) they appeared darker and darker; and on the 22d of *December*, he could perceive upon the thickeſt end of one of the eggs, which ſtuck faſt, a little mite, that had worked itſelf ſo far out of the ſhell, as to make a continual ſtirring with four of its legs, but

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but not being able to faſten them any where, he ſuppoſed it would ſoon die: On the 25th, he further obſerved another mite got out of its ſhell; whence we may conclude, that as the chickens of hens, and the young of other animals, are not increaſed or nouriſhed in the eggs, unleſs the dam ſits on them, and that all their eggs are hatched about the ſame time; ſo here, on the contrary, the eggs of mites not being ſat upon, but from time to time, and the eggs laid on ſeveral days, the young muſt, conſequently, be hatched at different times. From theſe experiments we may obſerve, what an influence warmth has on the eggs of mites; for, from thoſe he carried in his pocket, young ones were produced on the 11th or 12th day; but thoſe he kept in a box upon his deſk, were not hatched in leſs than ſeven weeks time. Thus we ſee how regular the production of a mite is, and how admirable the ſtructure of ſuch an *Animalcum*; wherefore, ſuch as entertain that vulgar error, that a great many *Animalcula* are produced of themſelves, or out of corruption, may now be convinced of the contrary: Moreover, M. *Leewenhoeck* diſcovered both in cheeſe and otherways, a great many empty huſks or pellicles of mites, which he imagined to be moſtly the ſkins of dead mites; but when he now perceived, that the dead mites were not tranſparent, he began to conſider, whether theſe mites might not caſt their ſkins, as well as ſeveral other animals; but that demands a farther enquiry: After more than ordinary cold and froſty weather, in 1708, M. *Leewenhoeck* procured ſome mites, that were taken from a bladder, and viewing them with a glaſs, he ſaw that ſome of them were dead, and others ſtill alive, but very ſlow in moving. In the latter end of winter, he took a glaſs tube of about the length of a ſpan, and thickneſs of a common writing pen, wherein he put three or four mites, he judged to be females, and together with them a long ſlice of an ox's dried bladder, which he had laid in rain-water for a very ſmall ſpace of time, becauſe it was very hard; but he preſſed it again with a clean cloth, that the water therein might be no hindrance to the mites, and afterwards he ſtopped both extremities of the tube with little pieces of cork; but a few days after, he could perceive, that the little moiſture, evaporated from the ſmall piece of bladder, had fixed itſelf to the ſides of the glaſs in a great number of exceeding ſmall drops of water; and that the hairy parts of the mites had been ſo entangled in that ſmall quantity of moiſture, that they could not extricate themſelves therefrom, and

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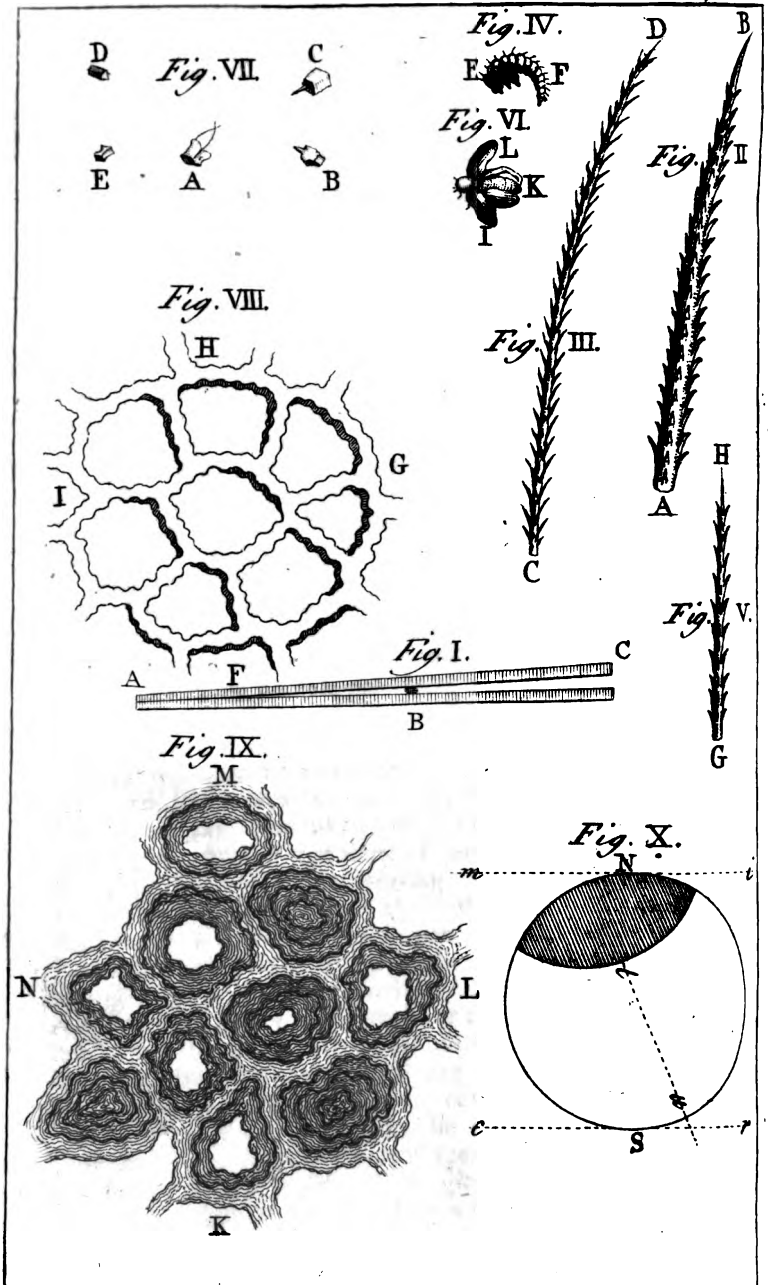

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Hulett Sculp

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ſo died; thereupon he opened the glaſs tube, and wiping it with a clean dry cloth, he again put a little bit of dry bladder therein, together with four mites; and viewing them in the great froſt, he obſerved that one of the mites had diſpoſed all his legs ſo exactly under his body, that as a perſon viewed him on the upper part, none of them could be ſeen; whence he concluded, that that mite was dead: Having again viewed the ſaid mite a day or two after the ſecond hard froſt, he obſerved, that it lay in the ſame place, and in the ſame manner, as it had done two months before; the other mites were alſo very much dried, and ſhriveled up, and their bodies bent double, and they likewiſe dead; however, fancying that the aforeſaid mite was ſtill alive, he viewed her again, and ſaw her begin to move one of her legs; whereupon, he warmed the glaſs tube a little, and obſerved that the little animal did not only ſtretch out her legs, but begin to creep very gently along; it ſeemed very ſurpriſing to M. *Leewenhoeck*, that ſo ſmall an animal ſhould live upwards of two months ſticking to the ſides of the glaſs in ſo ſharp a froſt; nor was its moiſture evaporated, whereas the dead mites were ſhriveled up in ſuch a manner, that they were not half ſo big, as when alive: Moreover, M. *Leewenhoeck* cauſed the painter to draw, as it appeared thro' the microſcope, the half of one of thoſe particles, repreſented by CD, Pl. XII. Fig. 3. that ſeemed to be hairs, and are found in great numbers on the bodies of bees. In the month of *Auguſt*, ſtanding by a fiſhmonger's ſhop, whilſt they were laying their dry-ling in water to ſoften it, he obſerved ſeveral little animals running about upon the fiſh; whereupon taking five of them, he put them into a glaſs tube, together with a little bit of the ſaid dried fiſh, in order to obſerve what ſort of animals would be produced from them; and after having ſhut them up for ſome days, he obſerved, that they had changed their ſkins, and made a great many holes in the cork that ſtopped one end of the tube, and ſo far inſinuated themſelves therein, that none of their bodies could be ſeen; theſe animals do alſo a great deal of damage to furriers; the caſt pellicle of one of theſe, juſt as it appeared to the naked eye, is repreſented between E and F, Fig. 4. Moreover, he placed a particle of the ſaid *Animalculum* before a microſcope, in order to view thoſe parts that appear like hairs to the naked eye, and he found that theſe long particles were encompaſſed with other parts, branching, or ſpringing out of

the ſides thereof, in the ſame manner as thoſe of the mite and bee above-mentioned; and yet, as ſmall as thoſe parts are, each of them has a hole, or cavity, wherein thoſe hairy parts are planted, that ſtand on the new ſkin of the *Animalculum*; theſe hairy particles were upon the darkeſt part of the skin, and the whitiſh parts were the joints of the *Animalculum*; and ſome of them were long, and others ſhort, but otherwiſe of the ſame ſhape; he cauſed one of the ſhorteſt to be drawn, as repreſented between G and H, Fig. 5. and he judged it to be about half as long as the longeſt: Theſe *Animalcula* are not produced from fat, but from others of the ſame ſpecies, which had their beginning with all other animals. It was ſaid above, that theſe *Animalcula*, having caſt their skins, had dug ſo deep into the cork, that they could not be ſeen; but on the eighth of *September* he diſcovered two winged animals, like ſmall beetles, whoſe fore and hinder part was black, and the middle brown, with ſome ſpeckles; and they had two ſhields upon their bodies, which covered their wings, and the skins they had caſt, after coming out of the cork, lay about the glaſs: Now to ſatisfy himſelf, that the ſaid *Animalcula* were changed from worms into flying animals, he opened two of the holes, they had made in the cork, and obſerved an *Animalculum* lying in one of them, which, indeed, had caſt its skin, but was not yet become black, but ſtill continued white, and about the ſize of a common ſmall fly: On the 11th of *September* two more of the above-mentioned *Animalcula* came out of the cork; and the female, which at firſt was all white, and ſtill like an *Aurelia*, and ſtirred very much, became red, and afterwards turned to a darker red: On the 17th of the ſame month, the *Aurelia* had caſt its skin, which was exceeding thin, and ran about the glaſs, but it was not arrived to that blackneſs others had, that had run longer about the glaſs.

IKL, Fig. 6. repreſents one of thoſe *Animalcula*; IL, the two little ſhields that cover the wings, when it does not fly; K, the tail, or hinder part of the body, on each ſide of which are the wings, which were partly folded up; for, that *Animalculum* cannot ſheath its wings in its ſhields, without partly folding their extremities: Now, ſince we ſee, that the worms, whoſe skin is repreſented by Fig. 6. are turned into flying animals, which lay their young, or eggs, in all parts of a houſe; and ſince it is natural to all animals to ſtow their eggs, where

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where they can be beſt preſerved and hatched, it will not appear ſtrange, that theſe animals are moſtly found upon furs that are fat: M. *Leewenhoeck* took a little bit of the fat of an ox, and laid it by theſe *Animalcula*, but he could not perceive that they fed upon it. About the latter end of *May* he ſearched for ſome mites on a piece of dried fleſh of a whale, which hung upon a little ſtring faſtened to a nail in his cloſet, and he perceived that ſeveral of the ſaid blackiſh *Animalcula* fell off from the piece of whale's fleſh, and this happened four times ſucceſſively on ſeveral days; whereupon, he put moſt of the flying animals into a glaſs-tube, which he ſtopped in ſuch a manner, as not to exclude the air, and he put into the ſaid tube a little bit of whale's fleſh, upon which he obſerved that they fed greedily, and that a great deal of their excrement lay upon the glaſs. On the 31ſt of *May* he obſerved three eggs lying upon the glaſs, and they were white; but having none of that viſcous matter about them, which the eggs of moſt of the *Animalcula* have, they did not ſtick to the glaſs, but fell among the excrements, ſo that he could not diſtinguiſh them: In the firſt glaſs tube, wherein were thoſe *Animalcula* he had ſhut up all the winter, and that were turned into flying animals, he obſerved two young *Animalcula* running about, whoſe ſkins are repreſented by Fig. 4. but how many there were of them he could not diſcover, becauſe about a month before he had put into the tube the tail of a pole-cat, that they might ſubſiſt on the fur, which he was told they uſed to feed upon, and afterwards he put into the ſame tube a little bit of whale's fleſh; theſe young *Animalcula* were but little bigger than the above-mentioned eggs; and in a day or two after that, he could neither ſee eggs, nor any of the *Animalcula*; whence he concluded, that the above-mentioned flying animals had eat up both their eggs and young: He took the pole-cat's tail out of the glaſs, and examining it, found a live *Animalculum* therein, as ſmall as an egg, and it appeared very white to the naked eye; he ſhut it up in a little glaſs, together with a bit of whale's fleſh, and he perceived, that in a few hours after, it had aſſumed a roſy colour; he alſo found three eggs, in one of which the *Animalculum* was ſo large, that by a microſcope he could diſcover part of the body thro' the ſhell; and two days after, being the eighth of *June*, he could perceive thro' a microſcope, upon the wreathed or notched parts, red ſtreaks, upon which

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were long hairs; and in the evening the *Animalculum* was got out of the egg-ſhell, and next morning it had aſſumed a roſy colour: On the 13th of *June* he ſaw ſome few eggs upon the glaſs, whereupon he took two out, and put them into a glaſs tube of the length and breadth of a finger, leaving ſix or eight others in the aforeſaid glaſs; and taking the above-mentioned blackiſh *Animalcula* out of the glaſs, he carried the glaſs tube, where the two eggs were, about with him in his pocket, that he might ſee how much ſooner theſe would be hatched, than thoſe he left upon his desk in a large glaſs tube; and on the 15th of *June* he diſcovered young ones hatched from the eggs he carried about with him, as on the 20th were thoſe in the tube that lay upon his desk: On the 5th of *July* he obſerved that in both the glaſſes, that contained the above-mentioned worms, or rather running animals, ſome of them had left the bit of whale's fleſh, and lay very quiet upon the cork, inſomuch that he imagined they were going to be changed into flying animals, but he ſoon found his miſtake; for they only lay upon the skins they had caſt, and then the flying animals daily laid their eggs, out of which alſo came young ones, but moſt of the eggs that had been laid were eaten up; to prevent which, ſome of thoſe flying animals thruſt their eggs between the cork and the glaſs, inſomuch that ſome of the eggs became flattiſh; yet notwithſtanding that, young ones were hatched out of them; a few days after the fifth of *July*, he perceived, that ſome of the creeping or running animals had gnawed holes into the cork, where they had dug ſo deep, that one could not ſee their bodies: In the beginning of *Auguſt*, he view'd them again, but could not perceive any flying animals changed, as he expected, from the creeping ones; wherefore he cut off a little of the cork in two ſeveral places, where thoſe creeping animals had been digging, and he diſcovered an *Animalculum*, which had caſt its skin for the laſt time, and lay ſtill upon the hinder part of its body, and in the *Aurelia*, which was white; only that, upon the notches of its body, there were red ſtreaks, and when he went to touch it with a needle, it ſtirred its body very much: On the tenth of *Auguſt* he obſerved, that one of the *Aurelia*'s was ſtript of its little skin, which was exceeding thin; ſo that it was an agreeable ſight, as he viewed it thro' his microſcope; this *Animalculum* did not ſeem to have any motion in it, and it was of a dark colour: In all his obſervations, M. *Leewenhoeck* never

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never could perceive any copulation among those *Animalcula*, when changed into flying animals; whence he concluded, that they were all females, as several other flies are. M. *Goedaart*, in his second part, N. 114. of the origin and properties of worms, caterpillars, &c. calls these animals he describes, p. 168, the *furrier's plague*; and says, he found of them in the feathers of a duck, and supposes them to be produced from fat; from whence it appears, that notwithstanding all the pains the said *Goedaart* bestowed in his enquiry after those animals, which he calls bloodless, he was got no farther than to maintain, that there were *Animalcula* produced of themselves: M. *Leewenhoeck* kept these animals two winters shut up in glass tubes, and he judges they can secure themselves in wood against the winter, because they had dug deep into the cork; insomuch, that if he had not hindered them, they would have bored thro' in several places.

An Account of an hydropical case, in which the Gall-badder was very much distended; by Mr. Yonge. Phil. Trans. N° 333. p. 426.

MRs. *Dyer* was about thirty years of age, the mother of several children, and very healthful till *January* 1711, when after frequent watchings upon an extraordinary occasion, she was afflicted with a pain in the belly, like the cholic, but which proved to be an *Ascites*; which increased so fast, in spite of all Mr. *Yonge*'s endeavours, that on *March* the ninth, being almost suffocated, he was obliged to tap her with a hollow needle in the usual place, and to repeat the operation as often as she filled; and by that means she brought away the several quantities of water at the times here mentioned; *March* 9, he drew off nine pints; the 14th, eight pints; *April* 2, twelve pints; the 16th, ten pints; *May* 17, fourteen pints; 31st, fourteen pints; *June* 14th, fourteen pints; the 24th, fourteen pints; *July* the 7th, seventeen pints; the 21st, sixteen pints; the 30th, sixteen pints; *August* the 6th, fourteen pints; the 17th, fourteen pints; the 26th, thirteen pints; *September* 1st, 6th, and 22d, eleven pints and a half; *October* the 1st, three pints; and the 30th, fifteen pints; so that in in the space of eight months he drew off 214 pints and a half of water: She died *November* 4, 1711, and opening her belly, there issued out fourteen pints of a greenish *Serum*, mixed with

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with a very purulent matter, not a little fœtid; the inteſtines, eſpecially the *Colon*, were livid almoſt every where, and adher'd in ſeveral places to the *Peritonæum*, tho' they had been ſo long immerſed in water; the *Omentum* was alſo black, and almoſt conſumed; the liver, which he expected to be indurated, had no blemiſh, only two ſuperficial ulcers on the left lobe; both that and the *Peritonæum* (which are uſually full of *Hydatides* in hydropical perſons) were quite free of them; but there were ſeveral on the ſtomach and guts; he found a large bladder, diſtended like that of an ox, filling up almoſt the whole region of the liver and ventricle, and adhering ſo firmly to the adjacent parts, that he could not ſeparate them without difficulty, and extract them whole; which prov'd to be the gall-bladder, and by its diſtenſion it had torn the liver aſunder, one part of which adher'd to the left ſide of this prodigious *Cyſtis*, and another part behind it, towards the back, and both expanded with it and faſtened to it, in the manner as the temporal muſcle is to the ſcull; the whole weigh'd 10 pounds and 12 ounces; it had no paſſage to let out the matter it contained, tho' he ſqueezed it hard to that purpoſe; nor could he find any by probes; ſo that he was obliged to make way by a knife, and let out of it ſeven pints of a black liquor, like coffee; which having ſtood a night in a baſon, near a quart of thick yellow *Feces* ſubſided: The liquor in this bladder, and what was found in her belly after her death, added to what was diſcharged before by *Paracenteſis*, amounted to 235 pints; beſides the prodigious quantity of matter, which filled this large bag, he found ſeveral pieces of membranes, like a gut, or bladder cut into pieces; it was very ſurpriſing, that during the whole time of her ſickneſs, ſhe diſcharged by urine near as much as ſhe drank; and yet by computation ſhe leaked into the *Abdomen*, from *March* to *November* following, near a pint every 24 hours: When her belly was near full, her thighs and legs uſed to ſwell, and grow diſcoloured, like an approaching gangrene; but both went off after tapping, by friction, and a warm lotion.

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The Head of a monſtrous Calf, by Mr. Craig. Phil. Tranſ. N° 333. p. 429.

A Butcher brought Mr. *Craig* the head of a monſtrous calf, which he had taken out of a cow's belly; the upper jaw was divided into two halves, as far as to the *Dura Mater*; each half had a diſtinct eye and noſtril; and the lower jaw was bent round ſo entirely, that it lay exactly between the two halves of the upper jaw, making the tongue lie upon the forehead, about two inches above the teeth of the under jaw, and in the fiſſures of the upper jaw; this preternatural diviſion of the upper jaw was not covered with hair, but with a *Cutis* of a florid colour; the calf was come to its full time, and made great ſtrugglings, when the butcher knocked the cow on the head; which by ſome ſymptoms they judged would have died in the calving; it was ſuch a large calf, that an old experienced butcher affirmed, he never ſaw but one other ſo large at calving; the legs and feet were as big as thoſe of an ordinary calf of ſix weeks old: Mr. *Craig* opened the calf's head, and after he had cut the ſkin (for there was no *Cranium*) that was expanded over the fore-part of the cavity containing the brains, he was ſurpriſed to find, that there was very little brains therein; nay, not ſo much as in a rabbit, the whole cavity not being large enough to hold an ordinary walnut: A week before the cow was killed, (upon apprehending ſhe had a dropſy) the butcher cut a hole in her belly, a little above the udder, and thruſt in his hand; but finding nothing extraordinary, he ſew'd up the hole, and the cow eat her hay, and was as well as ever.

Experiments about keeping Fiſh in Water under different Circumſtances; by Mr. Francis Hauksbee. Phil. Tranſ. N° 333. p. 431.

THE fiſh, Mr. *Hauksbee* made uſe of in the following experiments, were gudgeons; which are very briſk and lively in the water, and live a conſiderable time of it; he put three of them into a glaſs veſſel, with about three pints of common water, and he put three more into another glaſs, with a like quantity of water, which juſt filled this glaſs to the very brim; upon which he ſcrewed down a braſs plate with a leather between, to prevent a communication with the water in the glaſs, and the external air; and that it might the better reſemble a pond of water frozen over, (on which account this experiment

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experiment was made) he ſuffered as little air as poſſible to remain on the ſurface of the included water: The third glaſs had a like quantity of water put into it with the former, out of which its air was very accurately exhauſted, firſt by boiling, and afterwards continuing it a whole night *in vacuo* in the air-pump; he alſo put into this water a like number of gudgeons, as into the former; thus (the fiſh being all put into their reſpective receivers) Mr. *Hauksbee* applied himſelf to wait the event, which was as follows; he began the experiments about half an hour after ten a-clock in the morning, and in about half an hour from that time, he obſerved, that the fiſh in the exhauſted water began to diſcover ſome uneaſineſs, by a more than ordinary motion in their mouths and gills, or in their reſpiration, differing from the fiſh included in the other glaſſes, which at the ſame time diſcovered no alteration; only he obſerved, that they would now and then aſcend to the top of the water, but ſuddenly ſwim down again; and in this ſtate they continued for ſome conſiderable time, without any ſenſible alteration; about five hours after the laſt obſervation, the fiſh in the exhauſted water were not ſo active (upon a motion given the glaſs that contained them) as before; and the gudgeons included without any communication with the external air, began now to abate conſiderably of their vivacity, yet at times they ſtill continued their motions upwards and down again; at ſeven in the evening, the included fiſh lay all at the bottom of the glaſs, with their bellies upwards; nor could he, upon ſhaking the glaſs, put them in motion, nor cauſe them to ſtir their fins or tails; only he could perceive a motion in their mouths, which ſhewed that they were not quite dead: In this ſtate they lay for ſome time; but conſidering that the experiment would not be compleat, if he did not attempt their recovery, by taking off the braſs-cover, being very ſure they muſt have died in ſome little time, under the circumſtances they were then in, he accordingly took off the cover, and gave the ſurface of the water a free and open communication with the external air; at about ten a-clock at night he obſerved them again, at which time their recovery was ſo evident, that upon diſturbing a little the glaſs that contained them, they were actually in motion again; and at this time alſo the fiſh in the exhauſted water began to appear more brisk and lively than at the laſt obſervation: Here Mr. *Hauksbee* obſerves, that notwithſtanding the water was exhauſted of its air to a very great degree, yet the fiſh included therein did not ſo much as once

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once ascend in it, but continued always at the bottom, as those in the common water did; at this time he left them till next morning, when about eight a-clock he found them as perfectly well, and lively in all the glasses, as when they were first put in; those in the common water, exposed in the open air, suffered no manner of alteration during the whole time: After this, Mr. *Hauksbee* tried, whether the air had again insinuated itself into the exhausted water, and whether that might not be the occasion of the fishes recovery; accordingly, he put it on the plate of his pump, in the same glass with the fish, and being covered with another receiver, the air was exhausted; yet he could perceive very little air ascend therein, and it seemed to him to be much in the same state, as when the fish were first put in; he continued it *in vacuo* about an hour and a half; the fish did almost all the time continue at the top of the water, and appeared at that time, as if they were dead; for, upon letting in the air, they sunk hastily to the bottom, without any motion of their fins, or tails.

From the whole account Mr. *Hauksbee* observes, 1. That water, exhausted of its air, so far as the method here made use of, can do it, renders it not altogether unfit to support the lives of water animals; for, tho' when the fish were first put in, and for some hours after, they seemed to suffer some uneasiness; yet at length the water became more familiar to them; otherwise, he does not see, how their recovery should follow, since upon examination, little or no alteration could be found in the circumstances of the water, from the time the fish were first put in. 2. The fish included with their water, without any communication with the external air, plainly shews, that common water, in its natural state, is not alone sufficient to preserve the lives of its natural animals; hence it follows, that in ponds, when the water comes to be frozen over with a pretty thick ice, the fish in the said ponds are very likely, if not certain, to perish, upon the continuance of such a congelation for some time; unless, as in the latter part of the experiment, the impediment, which hindered the immediate contact of the air with the surface of the water, be removed; that is, by breaking holes in the ice, whereby it is restored, and will undoubtedly perform the same thing, as Mr. *Hauksbee*'s removal of the brass-plates: This is to be understood only in ponds, where the water is stagnant; for, where there are springs, or a current of water constantly succeeding under the ice, the effect, probably, will not be the same.

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An Account of Asbestos found in Scotland, *by Mr.* Blair, Phil. Trans. N° 333. p. 434.

MR. *Blair* had the following account from a gentleman in the *Highlands* of *Scotland* (not many miles from *Coupar* of *Angus*) who had built a house of a singular kind of stone, dug out of a quarry not far from him: This stone, after the rubbish, which is not very deep, is clear'd away, lies horizontally in a bed with parallel fibres, and few interstices; soft at first, and easy to be smooth'd and polished without any tool, but rather with sand, or a hard stone of a blueish colour; which afterwards hardens in such a manner, that it resists both the injuries of air and fire; when first the quarrier begun to dig it, endeavouring to cut, and raise it after the ordinary manner with wedges, and the other usual tools, it broke and crumbled all to pieces; but, afterwards observing more narrowly the direction of its fibres, he endeavoured to cut it lengthwise with spades; and by this means he procur'd stones as big as he had a mind to, which were smoothed very easily along the direction of their fibres; but when cut transversely, they could not be made smooth by any means, but their surface remained unequal, like the ends of a piece of wood: Tho' this quarry has but few interstices, yet in those the true *Asbestos* is lodged of a whitish silver surface, and consisting of several *Fasciculi* with parallel fibres, resembling those of the muscular fibres of salted beef, easily separable from each other, and pure white, till it become as small as the finest flax, and so ductile, that it may be spun into the finest thread, whereof it were easy to make the incombustible cloth, so famous for shrines among the ancients: In other places of those interstices there was likewise observable a reddish substance, nearly of the colour of *Sanguis Draconis*; but, whether fibrous or not, Mr. *Blair* could not say, having seen none of it; but the gentleman added, that he believed it might be good for dying: Mr. *Blair* is apt to think, that the second kind was likewise fibrous, which might make a very beautiful cloth, being striped with the other: This whole quarry may be said to consist of *Asbestos* of different colours, the blueish sort being of a much coarser, and the white and red of a finer grain.

The

The Dimensions of some Human Bones *of an extraordinary size, dug up near St.* Albans *in* Hertfordshire; *by Mr.* William Cheselden. Phil. Transf. N° 333. p. 436.

THE circumference of the scull, according to its length, was 26 inches, and according to its breadth 23 inches; the greatest diameter of each *Os innominatum* was 12 inches; the left *Os Femoris* was 24 inches long, with only one, and that the *Great Trochanter*; the right *Os Femoris* was 23 inches long, with three *Trochanter* processes; each *Tibia* was 21 inches long: If all the parts bore a due proportion, this man must have been eight foot high: These bones were found near an urn, inscribed *Marcus Antoninus*, in the place of the *Roman* camp near St. *Albans*.

Microscopical Observations on the seminal Vessels, *muscular* Fibres, *and Blood of* Whales; *by M.* Leewenhoeck. Phil. Transf. N° 334. p. 438.

THE *Animalcula* in *Semine masculino* of a horse, and those of a dog, are of one and the same bigness, at least they appeared so to M. *Leewenhoeck* thro' the microscope; being very desirous to observe the *Semen masculinum* of a whale, in order to discover, if possible, whether the *Animalcula* in those large creatures did not proportionably exceed such as he had discovered in smaller ones; he for that purpose procured of the captain of a *Greenland* ship a piece of the *Penis* of a whale, *viz.* the thickest part of it, where it was joined to the body; and opening the *Vas seminale*, he scraped off a little of the matter that was therein with a knife, and mixed it with a little rain water, in order to separate the parts from each other; whereupon he observed in the said matter a great number of long quadrilateral particles, most of which had four right angles, but of different sizes, and several of them thrice as long, as broad; but he observed none so broad, as the diameter of the hair of a man's head, and the smallest was 100 times less, and in some few he could perceive no thickness at all: All the said particles, or little figures, were as clear as crystal, so that he concluded, that they were fixed salts; and the rather because they were so hard, that they were not dissolved in the water; and when this matter, which he had scraped off the vessels of the whale's *Penis*, had lain a little longer in the water, he discovered salt particles, the two longest sides of which ran parallel to each other,

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but the two ſhorteſt ſides were oblique; ſo that one extremity had an acute, and the other an obtuſe angle; and tho' the ſalt particles had lain at leaſt a week in water that was frozen, and afterwards diſſolved, yet he ſtill ſaw the ſalts floating therein: Notwithſtanding the ſeveral obſervations he made, he could not diſcover the leaſt particle that bore any reſemblance to the *Animalcula in ſemine maſculino*. The above-mentioned *Greenland* captain preſented M. *Leewenhoeck* with ſome ſlices of a whale's *Penis*, adding that a little of it grated, or cut into ſmall pieces, and boiled in milk or beer, was very good againſt the bloody flux, and that a neighbour of his, who had been ill of that diſtemper a whole year, was thereby cured; the ſaid captain alſo informed him, that a female whale (on the ſide of the *Uterus*, but a little nearer its tail) has two nipples, or teats, which yield milk, and that he had drunk of it: Some time after he brought M. *Leewenhoeck* two pieces of whale's fleſh, dried hard, a ſpan in length, and as thick as one's finger; they were as black as pitch; but he ſaid that when the fleſh was cut off, it was red; from its blackneſs M. *Leewenhoeck* concluded, that the blood was of a deep, or dark red, which the captain alſo confirmed, adding, that where the blood fell, it left a ſtain; M. *Leewenhoeck* cut the fleſh thro', both tranſverſely and lengthways, in order to diſcover the thickneſs of its particles; and after he had cut thin ſcales acroſs, they appeared of a bright red colour; but when thicker, they were of a dark red; and when very thick, they were blackiſh: In this operation he obſerved, that the ſmall fleſhy muſcles were ſurrounded with very thin fibrous particles, that looked like little membranes, torn to pieces; and upon ſeveral parts of theſe little membranes, there lay fat, which, when there is a quantity of it together, they call the *Train*; and theſe train particles lay preſſed together in the ſame manner, as thoſe of an ox; nor were they bigger than the particles of the fat of an ox; and ſeveral of theſe particles were like melted fat; inſomuch, that upon ſqueeſing the fleſh, the fat came out at its extremity: M. *Leewenhoeck* laid a ſmall part of this fleſh, after cutting it into little pieces, in water; and he obſerved, that the fleſh was thinner, when dry, than when ſoaked thro'; and in comparing the fleſh of a whale with that of an ox, he judged that the particles of the former were finer than thoſe of the latter: Now in order to ſhew the fineneſs, or ſlenderneſs of the particles of the fleſh lengthways, of ſo huge an animal as a whale (for this was above 50 foot long) he placed one of the hairs of his beard by one of the fleſh particles of the whale, and he judged,

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judged, that the ſaid hair was at leaſt nine times thicker than one of thoſe particles, which may be called a little fleſh muſcle, it being again compoſed of other long particles, or fibres: He could not aſcribe either a round, or hexangular figure to theſe little fleſh muſcles of the whale, becauſe they lay ſo compreſſed on each other, that they appeared in ſeveral ſhapes, but moſt of them inclined to an hexangular figure; and upon viewing them more accurately at their extremities, he obſerved that for the moſt part one fleſhy particle was wrapped up in ſix others, but not regularly; for one took up more room than another; inſomuch, that ſometimes the outer fleſhy particle did not touch the inner but in one point: When he cut the above-mentioned long ſlender fleſh particles, either acroſs, or obliquely with a ſharp knife, he could ſee therein a vaſt number of exceeding ſmall particles, of which one of thoſe fleſh particles conſiſted, and they likewiſe cut acroſs; and thro' the microſcope they appeared, as if one ſhould ſee with the naked eye ſmall grains of ſand lying upon them, and their extremities could alſo be diſcovered: In theſe his obſervations there appeared to him a great many fleſh particles, ſurrounded with little figures like rings, and very cloſe to each other, juſt as if you ſhould take a common iron wire, and twiſt it about with another very fine one; and M. *Leewenhoeck* formerly obſerved ſuch circular fleſh particles in the muſcular part of the paw, or foot of a gnat; but the rings lay cloſer to each other in the fleſh particles of a whale, than in thoſe of a gnat; and the fleſh particles, or fibres of a gnat, were as thick as thoſe of a whale: From the ſaid obſervations one may more firmly conclude, that when the muſcles are ſtretched out, the fleſhy particles have no wrinkles; and that when they lie in their natural poſition, then the fleſh particles have wrinkles; M. *Leewenhoeck* was exceedingly ſurpriſed at theſe his obſervations, having always imagined, that the fleſh particles of very large animals conſiſt of larger parts, in proportion, than others. In theſe diſcoveries it was very remarkable, that each of the above-mentioned long fleſhy particles appeared to him, as if they were wrapped about with a little thin membrane, which he obſerved in 1000 ſeveral places; and the more eaſily, becauſe, as the fleſh particles grew dryer, theſe fine ſkins, or membranes were ſeparated from them: The above-mentioned captain told M. *Leewenhoeck*, that the whale has three diſtinct ſkins; the uppermoſt of which is very thin, and the next to that as ſoft as velvet, but the third and undermoſt is a thick ſkin, called the *Sward*, and reſembles a hog's ſkin; ſoon after

after the ſaid captain gave M. *Leewenhoeck* a little piece of the firſt ſkin, which he ſaid was eaſily ſeparated from the ſecond, it was no thicker than a leaf of writing paper; having viewed that ſkin thro' a microſcope, M. *Leewenhoeck* judged it to be compoſed of ſuch flattiſh particles, as he could call by no other name than that of little ſcales, and which were no bigger than the little ſcales, of which the human ſcurf ſkin is compoſed; but whereas the ſcales of our ſkin are very eaſily ſeparated, and eſpecially the uppermoſt ſcales, which are often ſhed or caſt, thoſe of the ſkin of the whale are firmly united together: When he came to conſider the aforeſaid ſkin, with regard to its thickneſs, he judged it to be compoſed of no leſs than four ſkins, lying upon each other; but upon viewing it more nicely, he diſcovered, that there were at leaſt 20 ſkins upon each other; all which were compoſed of little ſcales, and of exceeding ſmall particles, that lay ſcattered under thoſe ſcales; but as carefully as he examined the ſaid ſkin, he could not diſcover therein the leaſt fibres, or veſſels. From theſe obſervations he concluded, that the aforeſaid uppermoſt ſkin was ſeparated of itſelf from the reſt, which the captain alſo confirmed, adding moreover, that he gave but one cut, or ſlit in the uppermoſt ſkin, and that then twiſting it about a round ſtick of wood, it came very eaſily off from the ſecond ſkin: In ſeveral of his obſervations M. *Leewenhoeck* diſcovered a great many ſalt particles, moſt of them of the colour of aſhes, ſhut up in the outer ſkin, which he ſeparated therefrom by rain water; theſe ſalt particles were twice as long as thick, having each of them four right angles; they lay coagulated in a very clear thin liquor, which did not evaporate, nor melt away in rainy weather; whence he concluded, that they were nothing but common ſea ſalt: Moreover, he obſerved a great many very ſmall ſalt particles, about as long as the former, but exceeding ſlender, M. *Leewenhoeck* alſo procured a piece of the ſecond ſkin of a whale, about as broad as his hand, and as black as pitch, with four or five protuberances, or bumps on it, about as big as the third part of a pea, occaſioned by the biting of the lice, of which there were great numbers upon the whale's body; this ſkin was dried hard, and almoſt half an inch thick; but it was not ſtrong, becauſe there were no veſſels, or ſinewy fibres, running thro' each other, as in the ſkins of beaſts, and common fiſh; only there were ſome ſmall fibres, whereby it was joined a little to the ſkin that lay underneath, and which paſſed as it were, in a right line to the uppermoſt ſuperficies of the ſkin; theſe ſtrings, or fibres lay ſo cloſe to each other, that there

was

was not above the breadth of two, or three hairs between them; they were transparent, or whitish, and in one of them he could discover a blood-vessel; the undermost, or third skin was whitish and so strong withal, that he concluded, in case the harping iron was struck so deep into the whale, as that the beard or hooks thereof should penetrate into the said white, or third skin, it would keep its hold; but if it went no farther than the black skin, it would easily be torn out: After all his endeavours he could not discover the parts of the aforesaid black skin; for when he cut it very thin, he judged it to be full of a great many small pores, or openings, and that upon this account it was not so heavy, as he supposed a close solid body should be; and he saw therein little black spots, standing so near each other, that one could hardly thrust in a hair between them, and these spots were the cause of its being lighter; thus he also observed in several places of the skins of beasts, between the parts, whereof the skin consists, a great many little globules, which be found to be fat; but in the aforesaid skin he could discover no fat, which seemed very strange to him, because whales have commonly, 10, 14, 15, or more inches thick of fat (which is called bacon) under the third skin: Moreover, M. *Leewenhoeck* observed, that the black skin was clammy, or glutinous, when wet; whence he concluded, that a very good glue might be extracted from it.

From the black skin, and black blood of a whale, M. *Leewenhoeck* was led to consider the black blood of a salmon; and he supposed, that the redness of the flesh of that animal, was only occasioned by the blackness of its blood; and that in like manner the blackness of whale's flesh was owing to the same cause; hence he began to consider, whether the blackness of the *Guinea Negro's* might not likewise proceed from their black blood; and whether also their flesh might not be blacker than that of white men: Now since we see that the particles of flesh, fat, and little membranes of a whale, are no bigger than those of an ox, and that the bulk of animals only depends on the number, or quantity of their parts, we may easily conceive, why the *Animalcula in semine masculino* of a whale, are not bigger than those in common quadrupeds: As to the fat of a whale, called bacon, and from which the train oil is boiled, M. *Leewenhoeck* found the parts as fluid, as those of the fat of river fish; for he had often viewed with a microscope the fat of an eel, and it was an agreeable sight to observe the globular particles, which lay compressed as it were, in each other, but this pleasure was transitory by reason of the fluidity of those parts.

Obser-

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Observations in a Journey thro' Italy *in* 1703; *by Dr.* J. P. Breynius. Phil. Transf. N° 334. p. 447. *Translated from the* Latin.

THO' *Leghorn* (situated in a plain on the sea shore, with high mountains on each side) be not very large, yet it is a neat trading town, and well fortified; the air is not very wholesome, and double *Tertians*, which are here of difficult cure, are frequent: *Pisa* is but a few miles off from *Leghorn*; the road is very pleasant, thro' a champaign fertile country, with several intermediate groves of oak, holm, cork and myrtle trees. *Pisa* was formerly a common-wealth, and a neat city, but now the second in order, and subject to the *Grand Duke* of *Tuscany*, it has lost much of its pristine magnificence, and of the number of its inhabitants; the university here was formerly more famous than it is now; it has four colleges; the first called *di Sapienza*; the second *di Ferdinando*, built by *Ferdinand* I. *Grand Duke* of *Tuscany* in 1595, on that spot of ground where stood the house of the celebrated lawyer *Bartholus*, as the inscription shews; the third *Puteano*, from *Puteus* a bishop, and erected in 1605: The famous botanic garden at *Pisa* was founded by *Cosmus* I. *Grand Duke* of *Tuscany* in 1547, seven years after that of *Padua*; and *Lucas Ghinus*, according to *Castellus* in *Opt. Med.* was the first botanic professor, to whom succeeded that prince of botanists, *Andreas Cæsalpinus*; *Jo. Antonius Bumaldus* (the anagram of *Ovidius Montalbanus*) in his *Bibliotheca Botanica* mentions the said *Lucas Ghinus*, as the first founder of public college gardens; the house adjoining to the garden, wherein are kept a great many rarities both natural and artificial, was founded by *Ferdinand* I. in 1695, as appears by an inscription on the gate; in the court before you come to the gardens, a great many whale-bones are ranged; and in the upper part there is a repository for natural and artificial curiosities, disposed in very good order.

In the portico of the garden, are hung up the effigies of *Cæsalpinus*, *Clusius*, *Casaubon*, *Matthiolus*, *Pona*, &c. In the upper rooms there is a large pneumatic engine, with some other philosophical instruments, as also furnaces with a chemical *Apparatus*; the garden itself is pretty spacious, but kept in no exquisite order, containg 1500 different species of herbs, but generally ranged in no certain manner: The aqueduct at *Pisa*, which conveys water to the city for the space of five *Italian* miles, is old and ruinous: It is to be observed of the famous inclining

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clining tower at *Pisa*, that its foundation on that side, where it inclines, did at, or soon after its being built, sink down; and hence, contrary to the intention of the architect, this tower acquired that inclination, so much talked of, and this plainly appears to the naked eye.

The road from *Pisa* to *Lucca*, is first thro' a fertile plain, and the fields being surrounded with mulberry, laurel, poplar, fig-trees, &c. and vines, renders it very agreeable; afterwards you cross the mountain of St. *Julian* (famous for savory) which tho' high and rocky, yet yields some rare plants. At the foot of this mountain the jurisdiction of the republic of *Lucca* begins, where olive trees grow, which are said to yield the best oil, as also chesnut, arbute, and turpentine trees, loaded with ripe fruit; and at length a fertile plain begins to open, abounding in vines as far as *Lucca*, the metropolis of this republic, where nothing occurred in particular, relating either to physic, or natural history; only he observed in this territory, as he had also in *Tuscany*, a great many fields sown with the common white lupines, which they boil and eat; besides vetches, millet, sorg-seed and panick in other fields, partly for the use of man, and partly for feeding pidgeons, and other birds: From hence thro' *Pistoia* you direct your course to *Florence*; and here in this large and neat city a thousand curiosities, recounted by others, but more especially in a book, entitled *Ristretto delle Cose più notabili della Città di Firenze*; the most remarkable are the repository or cabinet of the *Grand Duke*, called *Galeria*, where there is the greatest collection of the most valuable curiosities in art; and the magnificent chapel of *San Lorenzo*, designed for the burying-place of the *Grand Dukes* of *Tuscany*; to which you may add the *Grand Duke*'s gardens: The greatest ornaments of *Florence* at that time were the celebrated *Bellini* and *Magliabechi*; the former chief physician to the *Grand Duke*, and well skilled in physic, especially the theory, as the several works he has published do abundantly testify; and tho' a very great man in other respects, yet not so successful in practice, a thing that has been often observed of others: He received Dr. *Breynius* with greater frankness than he usually did others; he was of a low stature, then about 60, and broken with a complication of diseases, and had a cataract for five years on his left eye: In a conversation Dr. *Breynius* had with him on various subjects in physic, he affirmed, that there was nothing in medicine, but what might be found out by genius, and application; since every thing is performed by mechanical laws, excepting the figures of the mi-

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nuteſt particles and elements; and that this was the reaſon, why phyſic would never arrive to perfection; he informed the Dr. that the *Tetuzzi* waters, ſo much cried up in curing dyſenteries, was a ſpring near *Piſtonia*, which contained a common, or ſea ſalt, and had a purgative quality; hence ſea ſalt diſſolved in fountain water was ſometimes given poor people with the like, tho' not always equal ſucceſs: He ſaid, he had writ a great deal, which perhaps would never ſee the light; For ſome years he had applied himſelf to muſick and poetry, which he ſaid he liked exceedingly, being diſtracted with continual meditations. The other famous perſon was *Magliabechi*, library keeper to the *Grand Duke*, and his brother the Cardinal; a man of vaſt acquaintance with books, and by the *Grand Duke* deſervedly called his living library; amongſt phyſical books, as alſo books of natural hiſtory, of which there were a great many, the moſt remarkable was a thick volume, containing lively figures of plants, repreſented in their native colours, with their names in manuſcript, entitled; *Viridarium Botanicum, in quo Arborum, fruticum, ſuffruticum, ſtirpium, & plurimarum plantarum tam indigenarum, quam exoticarum ſpecies, læte virentes perennantur, quas e diverſis locis collegit & delineavit, coloribus naturam imitantibus pinxit, & celebrium Botanicorum Nominibus diſtinxit* Joſephus Baldius, *Medicus, Phyſicus, Civis* Florentinus, *Academicus Apatiſta* 1650. As to libraries, that of *San Lorenzo*, ſo called from the adjoining church of the ſame name, is not the leaſt conſiderable; being no leſs famous for its curious architecture, which it owes to the celebrated *Michael Angelo Bonaroti*, than for valuable MSS. (of which it chiefly conſiſts) in all faculties; and each of them chained down, as in the *Bodleian* library at *Oxford:* Amongſt phyſical pieces, what ſeemed moſt remarkable to the Dr. was, an old MS. in *Folio*, done upon parchment, with figures drawn to the life, particularly relating to luxations, with the following title; *Chirurgia Hippocratis, Galeni, Oribaſii, Heliodori, Aſclepiadis Bithynii, Archigenis, Dioclis, Amyntæ, Apollonii Ther. Nymphodori, Ruffi Epheſii, Apollonii Cyſienſis, Sorani, Pauli Æginetæ, Palladii.* This MS was tranſcribed, as *Magliabechi* aſſured the Dr. by *Jacobus Tollius*, after whoſe death it came into the hands of *Hainius* profeſſor of *Duysburg*, who deſigned to publiſh it; here is alſo a MS of *Dioſcorides*, written on paper, which yet ſeems not to be very old.

In the hoſpital of St. *Mary*, which is ſaid to be the largeſt in *Italy*, if not in all *Europe*, a vaſt number of ſick are well taken care

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care of: In the *Grand Duke's* chemical laboratory, which the *Italians* call *Fonderia del Grand Duca*, there are a great many chemical preparations, with furnaces and other implements; here the Dr. observed the method of making the various sorts of essences, which are in so great repute over all *Europe*, and commonly called *Essenzia di Bergamotte, Cedro*, &c. They are obtained by distillation (different from the manner used at *Rome*, which is by expression) from rinds, only adding common water; from which after distillation the oil that floats a top, and called the essence, is separated; here also are distilled odoriferous waters, made from flowers, without putting any water to them, and these are very good; besides this laboratory, there is the *Grand Duke's Pharmacopœia*; where the Dr. saw amongst other rarities, some monstrous *Fœtus's* preserved in spirits of wine; as a hare with eight feet, a puppy with two heads, and another with only one eye in the forehead, *&c.* What makes the disgrace of this neat city is, that most of their houses, as also some of their palaces have paper windows; but this more frequently at *Pisa* and *Lucca*. On the 30th of *October* he set out for *Rome*, and in his way thither, passed thro' *Siena*, famous for the purity of the *Italian* tongue, and afterwards he crossed the high mountain *Radicofani*, at the foot of which begins the *Papal* jurisdiction: *Bolsena* is a town situated on a lake of the same name, to the left hand of which the high road passes near an oak wood; the trees here are lower than ordinary; and loaded with the larger galls, and full of the *Pillulæ capillatæ* C. B. but more justly according to *Lobelius excrementum spongiosum & muscosum Bedeguaris effigie*: The *Quercus calyce echinato, glande majore* C. B. is also frequent here; the mountains are rocky, in several places consisting of a sort of marble called *Basaltes*, and cut out into a great many caverns, and grotto's: *Monte-Viasconi* is famous for the best muscadine wines, and the sepulchral inscription *Est, Est, Est*, for which see *Misson dans son voyage d' Italie*; where it is to be observed; tho' he finds fault with others upon this account, that he himself has mistaken the inscription, which runs thus;

EST EST EST PPR NIUM
EST HIC JO. DEUC. D.
MEUS MORTUS EST.

On this road, *Viterbo* is the largest and most remarkable town next to *Siena*, and subject to the *Pope*; on the right, at

about a mile's distance, there are hot mineral waters called *Bulicanti*, *bubbling* or *boiling springs*; they rise in a declivity, in a whitish, dry, and as it were, calcarious soil, and they soon discover themselves by their sulphureous smell and smoke; they also taste somewhat sulphureous and brackish; the chief or primary springs are situated on a somewhat higher ground, and consisting of several streams bubbling out of the earth, are surrounded with a low stone-wall of an heptagonal form; and nearly as large as the King's *Bath* at *Bath*, in *England*; on one side of the wall is cut in stone the following inscription.

D. O. M.
Ars Ortulanorum
fecit A. D. MDC.

This water is very hot, so as to scald the hand, if held any time therein, and soon harden eggs; from these primary springs arise four streams with a swift current, that furnish the adjoining secundary springs, whose warmth is much abated; the bottom of the rivulets or streams is rocky, and whitish from the calcarious sediment of the water, in which it abounds, as appears by the stalks of hemp being all covered over with a like stony and calcarious crust; this concreted sediment is in several places of a greenish colour, which it also communicates to the water: These waters seemed to be almost quite neglected, which was not a little surprising to Dr. *Breynius*; tho' he would not advise the taking them internally, by reason of the great quantity of calcarious particles they contain; moreover the inhabitants are wont to steep their hemp in these secundary springs.

Some Remarks on the Parchment MS. *in* San Lorenzo *Library at* Florence; *mentioned in the preceeding Observations; by M.* Schelhammer. Phil. Trans. N° 334 p. 459. *Translated from the* Latin.

ACcording to *Conringius*, we have no writers on surgery among the ancients, excepting *Hippocrates*, *Galen* and *C. Celsus*. Vide Herm. Conringii *Introd. in Artem Medicam.* cap. xii. p. 401.

But if we may credit M. *Spon*, famous for his skill both in surgery and antiquity, there are a great many authors on the subject, but which remain unpublished, amongst the MSS in the Grand Duke of *Tuscany*'s library; for, in his *Itinerary*, speaking of the curiosities of *Florence*, he expresses himself to the following

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ing purpose; 'I shall mention another MS, relating to the art I 'profess myself, and which is the only one extant, as far as I 'know, in all the libraries in *Europe*; it is a huge *Greek* vo- 'lume, containing the surgery of the ancients; *viz.* of *Hippo- 'crates*, *Galen*, *Asclepiades*, *Bithynus*, *Apollonius*, *Archigenes*, 'Nymphodorus, *Heliodorus*, *Diocles*, *Ruffus Ephesius*, and 'Apollodorus Cytiensis, in which piece are to be seen figures 'drawn upon parchment, that represent the method of reducing 'luxated bones; there is sometimes mention made in *Pliny's* 'works of *Apollodorus Cytiensis* as well as of *Asclepiades*, *Apol- 'lonius* and *Diocles*; and *Archigenes* is no uncommon name in '*Galen*; but their entire works are found no where; and the 'names of *Bithynus*, *Nymphodorus*, and *Heliodorus* are scarce 'known to us.' Indeed, if all this were true, as M. *Spon* repre- sents it, it would be no small detriment to surgery, that so excel- lent a work should be consigned to oblivion; which must neces- sarily contain very curious and those very useful observations; for, it is both consonant to reason, and the thing speaks of itself, that there were a greater number of just observations made in those ancient times, when surgery flourished among the sons of physick, than can possibly be expected in our days from operators, gene- rally unlearned and unskilled in anatomy: But M. *Spon* seems to have been imposed on by his too cursory and hasty survey; for upon *Schelhammer's* consulting *Meibomius*, the most sagacious inquirer into medical antiquities, and who being a great while at *Florence*, had access to the Grand Duke's library; he returned the following answer; 'I know the book very well, says he, 'which a certain physician *Nicetas*, but of what age I know not, 'collected from the ancient surgeons; and while I was at *Florence*, 'I had access to it, being in the 74th shelf, and I transcribed a 'great deal out of it; yet the same collection is extant, not only 'in the library at *Florence*, as M. *Spon* imagines, but likewise 'in the King of *France's* library; nor have all the things con- 'tained therein been unpublished, nor are they all of the same 'consequence, much less are their authors unknown: I found 'therein some entire books, and only some small fragments of 'others; I shall say nothing of the works of *Hippocrates*, *Galen*, '*Oribasius*, *P. Ægineta*, *Ruffus Ephesius*, and *Palladius*, 'which are otherwise well known and have been already pub- 'lished; I shall only say something of *Bithynus*, *Nymphodorus*, 'and *Heliodorus*, because M. *Spon* takes their names to be almost 'unknown; which may be very true of *Bithynus*, who is an au- 'thor of M. *Spon's* imagination; the fragments in that book

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'are thoſe of *Aſclepiades* of *Bithynia*, or *Pruſienſis*, of whom 'there is ſo often mention made in *Pliny* and *Galen*, and of whom 'M. *Spon* makes two, *viz.* *Aſclepiades* and *Bithynus*; and with 'the ſame reaſon, he might have made two diſtinct authors of '*Ruffus* and *Epheſius*; *Heliodorus* is mentioned by *Ægineta* 'and *Oribaſius*, who commend his chirurgical works; and *Nym-*'*phodorus* might be known from *Celſus*, *Galen* and *Oribaſius*; 'and *Vidus Vidius* had then tranſlated and publiſhed *Heliodorus*, 'of whoſe piece on fractures there are xi chapters extant in this 'collection.'

Obſervations in natural Hiſtory *in* Wales, *1696 and 1697, by Mr.* Lhwyd. Phil. Tranſ. N° 334. p. 462.

AT *Snowden* hills Mr. *Lhwyd* met with little or nothing, beſides what is in Mr. *Ray*'s ſynopſis; only he found the little bulb plentifully in flower: He diligently ſearched in the mountains of *Glamorganſhire* for figured ſtones, but met with none, excepting cubical marchaſites and cryſtals; whereof he found one about nine inches long, and thicker than his wriſt, and the greateſt part of it as tranſparent as glaſs, but opaque towards the root, like white marble; he met with ſome ſmall ones of the colour of a topaz; and he was informed that others were purely amethyſtine, found in the valley of *Nant Pharanteon*: Mr. *Lhwyd* finds, that the old *Britons* (for want of more precious ſtones) made themſelves beads of opaque, or marble cryſtal; for he had one given him, cut like a ballot, and perforated, which was found in *Meirionydhſhire:* Mr. *Lhwyd* was at a loſs to know, whether thoſe tranſparent ſtones (mentioned by Dr. *Plot*, and Dr. *Liſter*, Phil. Tranſ. N° 201.) by the name of *Ombriæ*, &c. are naturally ſo formed; he had one given him (ſet in copper with a little handle to it) by the name of *Tlws Owen Ky veiliog*, i.e. *Owen* of *Kyveiliog*'s jewel; ſo called, becauſe found in an old crig, or barrow, near the place where he lived. Sir *William Williams* had ſeveral *Welſh* MSS. but no dictionary; chiefly modern copies out of *Hengwrt* ſtudy in *Meirionydhſhire*; and Mr. *Lhwyd* took a catalogue of all the ancient MSS. it contains; among others are the works of *Talieſyn*, *Aneworyn Gwawdydh*, *Myrdhyn ab Morvryn*, and *Kygodio Elaeth*, who lived in the fifth and ſixth centuries (but the ſmall MS. containing them all, ſeems to have been copied about 500 years ago) as alſo of ſeveral others valuable in their kind: In *Wales* they have neither the *Ibex* nor *Rupicapra*, nor any other goat but the common ſort; the park deer is in *Welſh* called *Geivr Danas*; the former word

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fignifies goats, but whether the latter denote *Daniſh* (as if deer had come from *Denmark*) or ſomewhat elſe, is unknown: The lakes tho' very numerous, yield no other fiſh beſides trout and eel, and *Torgoch* and *Gwiniad*, i. e. *Shelly* and *Charre*; a fiſherman aſſured Mr. *Lhwyd*, that in a lake called *Lhyn y Cwn* near *Lhan Berys*, he had ſeveral times caught monocular trouts, whoſe heads were always ſomewhat diſtorted or awry; they farther aſſured him, that the higheſt lakes of *Snowdon*, viz. *Phynnon Urâth* and *Phynnon Las*, yield no fiſh at all, and that the trouts of the other lakes differ much in colour. There is neither ſulphur, nor pumice-ſtone on the tops of the mountains, nor any other thing, that ſhould ſeem to be the effects of vulcano's; what ſeemed to him moſt ſurpriſing, were waſte confuſed heaps of ſtones, and to appearance fragments of rocks, ſtanding on the ſurface of the earth, not only in wide plains, but alſo on the ſummits of the higheſt mountains: He never obſerved any lake or ſpring on the ſummit of a hill; it is true that on the tops of ſome hills, where formerly ſtood caſtles or forts, certain wells are ſeen, called in *Welſh Pydew*, a word of the ſame ſignification, as well as ſound with the *Latin Puteus*; but no water runs out of them, and ſeveral of them he found quite dry. The grey game (as it is termed) ſeems to be the female of the black, which they call *Gryg-ieir*, i. e. *Gallinæ ericetorum*; the red game they call *ieir y mynydh*, i. e. *Gallinulæ montanæ*; becauſe in *Wales* they keep to the higheſt hills, in *Welſh banneu*, eſpecially if heathy. In *May* 1696, there came into *Cardiganſhire* two ſtrange birds (as he conjectures by the deſcription given of them) of the aquatic fiſſiped tribe; they were ſaid to be almoſt two yards tall, and of a whitiſh colour, with the tips of their wings dark; Mr. *Lhwyd* took them to be ſome ſort of exotic crane. About two years before, there came a flock of birds, upwards of 100, to a hemp-yard, at a place called *Lhan Dhewi Velfrey* in *Pembrokeſhire*, and in one afternoon deſtroyed all the hemp-ſeed; they were about as big, or little leſs than black-birds, with bills more ſtubbed, and bigger than that of a bull-finch; Mr. *Lhwyd* ſuſpects theſe to have been *Virginia* nightingales; they were exceeding tame, or at leaſt ſo intent on their food, that being driven from their places, they would not remove above two or three yards; the cocks were of a deep ſcarlet colour, without any diſcernible diſtinction in the feathers of their wings, excepting that the tail, and lower part of the belly were a little paler; the hen had a lovely ſcarlet breaſt, and her head and back were grey.

Mr.

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Mr. *Lhwyd* discovered some new species of *Glossopetræ*, and *Siliquastra* (the first *Ichthyodontes*, he supposes, that ever were observed in *Wales*) on the top of a high mountain, called *Blorens*, near *Aber Gavenni*; the *Siliquastra* were generally smaller than those he had observed in other countries; he found one *Glossopetra* pretty large, but the rest were very small, all black or atro-rubent; the same place also afforded some variety of fossil shells, and a great number of *Cuthbert's beads*, which were very small in comparison of those found throughout the north of *England*; he likewise found there a large, testaceous body, not to be compared, as to its shape, with any sort of shell hitherto described; together with some embossed representations of pieces of the skeletons of eels, or some smaller fish: All these were in lime-stone; but advancing about three miles farther into *Brecknockshire*, at a place called *Lhan Elhi*, he examined some coal and iron mines there; their coal-works were not pits, sunk like draw-wells, but large inroads made into the side of the hill, so that three or four horsemen might ride in a-breast; the top is supported with pillars set up at certain distances; and they make their by-lanes, as in other pits, according as the vein requires; the slate above this coal afforded only stalks of plants; close by the pit he found a valuable curiosity, *viz.* a stone in substance like those they make lime of, of a compressed cylindrical form, and cut off even, at each end, as it were, about eight inches long, and three inches broad; its superficies was adorned with equidistant dimples, resembling Dr. *Plot's Lepidotes*, Hist. Oxford. c. v. § 55. and in each dimple a small circle, and in the center of each circle a little stud, like a pin's head; this was the only curiosity of the kind he saw, which is not referable to any thing either in the animal, or vegetable kingdom; amongst the iron ores of the same hills he found some new spars, and several specimens of ore, shot into a constant and regular figure, tho' not reducible to any animal or vegetable bodies: About five miles thence, at a place called *Pont y Pwl* in this country (where, as also at *Lhan Elhi* there are furnaces and forges) he found more coal and iron mines, and collected some representations of the leaves of capillary plants on the iron ore; but found no branches: One major *Hanbury* of this *Pont y Pwl* shewed Mr. *Lhwyd* an excellent invention of his own, for beating out hot iron (by the help of a rolling engine, moved by water) into as thin plates as tin; they cut their common iron-bars into pieces about two foot long, and heating them glowing hot, place them between these iron rollers, not a-cross, but with their extremities lying the

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ſame way with thoſe of the rollers; the rollers, moved with water, drive out theſe bars to ſuch thin plates, that their breadth, which was about four inches, becomes their length, being extended to about four foot; and what before was the length of the bars, is now the breadth of the plates; with theſe plates he makes furnaces, pots, kettles, ſauce-pans, &c. At *Pont y Pwl* they had on the ſixth of *June*, an extraordinary ſhower of hail, which extended about a mile, and laſted near half an hour; it beat down all the beans and wheat within that compaſs; ſome of the hail-ſtones were eight inches about, and their figure irregular, ſeveral of them being compounded.

An Experiment ſhewing the Angle requiſite to ſuſpend a Drop of Oil of Oranges, at certain Stations, between two glaſs Planes, placed in the Form of a Wedge; by Mr. Francis Hauksbee. Phil. Tranſ. N° 334. p. 473.

MR. *Hauksbee* procured two glaſs planes, that meaſured a radius of 20 inches each, their breadth about three inches, the lower plane was placed with its ſurface parallel to the center of its axis, and parallel to the horizon; thus the planes, being very clean, were rubbed with a clean linen-cloth, dipped in oil of oranges; afterwards a drop or two of the ſame oil being let fall on the lower plane near the axis, the other plane was laid upon it; which as ſoon as it touched the oil, this latter ſpread itſelf conſiderably between both their ſurfaces; then the upper plane being raiſed a little at the ſame extremity by a ſcrew, the oil immediately attracted itſelf into a body, forming a globule contiguous to both ſurfaces and began to move forwards towards the extremities in contact; when it had arrived to two inches from the axis, an elevation of 15 minutes at the contingent extremities ſtopped its progreſs, and it remained there without moving any way: Then letting the planes fall again, the drop moved forwards, till it came to four inches from the center; and then an elevation of 25 minutes was requiſite to fix it; at ſix inches it required an angle of 35 minutes; at eight inches, of 45 minutes; at 10 inches, a whole degree; at 12 inches from the axis, the elevation was one degree and 45 minutes; and ſo on, at the ſeveral ſtations, as in the following table: This after ſeveral trials he takes to be the moſt correct, tho' the others ſucceeded very little different from the ſame; it is to be obſerved, that when the globule, or drop had arrived to near 17 inches on the planes from their axis, it would become of an oval form; and as it aſcended higher, ſo would its figure become more and more oblong;

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and unleſs the drop were ſmall, upon ſuch an elevation of the planes, as was requiſite at ſuch a progreſs of the drop, it would be parted, ſome of it deſcending, and the reſt of it running up to the top at once; but a drop that ſeparated thereabouts, he found that the remaining part thereof at 18 inches, would bear an angle of elevation, equal to 22 degrees to ballance its weight; higher than that he could not obſerve: The planes were ſeparated at their axis about the ſixteenth of an inch: Mr. *Hauksbee* found but little difference, as to the experiment, between ſmall and larger drops of oil: The angles were meaſured by a quadrant, marked on paper of near 20 inches radius, divided into degrees and quarters.

Diſtance in inches from the axis.	Angle of elevation. D.	M.
2	0	15
4	0	25
6	0	35
8	0	45
10	1	00
12	1	45
14	2	45
15	4	00
16	6	00
17	10	00
18	22	00

An Account of the Eruption *of a* burning Spring *at* Broſeley, *in* Shropſhire; *by Mr.* Hopton. Phil. Tranſ. N° 334. p. 475.

ABOUT *June* 1711, at *Broſely* near *Wenlock* in *Shropſhire*, (about two nights after a remarkable day of thunder) there was heard a terrible noiſe in the night, which awaked ſeveral people; who coming to a boggy place under a little hill, about 200 yards off the river *Severn*, perceived a mighty rumbling and ſhaking in the earth, and a little boiling of water thro' the graſs; upon digging up ſome part of the earth, the water flew up immediately to a conſiderable height, and was ſet on fire by a lighted candle: To prevent the ſpring being deſtroyed an iron ciſtern was placed round it, with a cover upon it, to be locked down, and a hole in the middle, thro' which one might ſee

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ſee the water; if you put a lighted candle, or any thing of fire to this hole, the water immediately takes fire, and burns like ſpirits of wine, and continues ſo to do, as long as you keep the air from it; but by taking up the cover of the ciſtern, it quickly goes out; the heat of this fire much exceeds that of any fire Mr. *Hopton* ever ſaw, and ſeems to have more than ordinary fierceneſs in it: Some people after they have ſet the water on fire, have put a kettle of water over the ciſtern, in which green peaſe, or a joint of meat are much ſooner boiled, than over any artificial fire; if green boughs, or any other thing, that will burn be put upon it, it preſently conſumes them to aſhes: The water of itſelf is as cold, as any water Mr. *Hopton* ever felt; and what is remarkable, as ſoon as ever the fire is out, if you put your hands into it, it feels as cold as if there had been no ſuch thing as fire near it.

Obſervations on the ſubterraneous Trees *in* Dagenham, *and other Marſhes bordering on the* Thames; *by Mr.* Derham. Phil. Tranſ. N° 335, p. 478.

THERE happened an inundation at *Dagenham* and *Havering* marſhes in *Eſſex*, by a breach in the *Thames* wall on an extraordinary high tide; and by means of the great violence of the water, a large channel was torn up, 100 yards wide, and 20 foot deep in ſome places, in ſome more, in ſome leſs; by which means a great number of trees were laid bare, that had been buried there for ſeveral ages before; they were all of one ſort, excepting only one, which was plainly a large oak, with the greateſt part of its bark on, and ſome of its head and roots; the reſt of the trees were ſuppoſed to be yew, from the hardneſs, toughneſs and weight of the wood, tho' there be no yew growing any where thereabouts; and it ſeemed ſurpriſing to Mr. *Derham* that yew ſhould grow in ſuch vaſt quantities, in ſuch a ſoil, and ſo near the brackiſh waters; ſome took it to be horn-beam, which grows plentifully in the higher lands, tho' never ſeen in watry places; but Mr. *Derham* rather inclines to the opinion of its being alder, (which grows plentifully by our freſh water brooks) the grain of the wood, and the manner in which the boughs grow, *&c.* reſembling that of alder much more than horn-beam: By lying ſo long under ground, the trees became black and hard, and their fibres ſo tough, that one might as eaſily break a wire of the ſame ſize, as any of them; they maintain this toughneſs if the wood be kept dry; but by drying the trees become crack'd, and very flawy within, but outwardly look ſound, and with diffi-

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ficulty yield to wedges; but thoſe lying in the marſhes, which are covered every flood, and laid bare every ebb, become in a ſhort time very rotten: Mr. *Derham* doubts not, but theſe trees grew in the place where they now lie, and that in vaſt numbers; for they lay ſo thick upon, or near each other, that in ſeveral places he could ſtep from one to the other; and he thinks it not improbable, that not only theſe marſhes, (which are about 1000 acres) are ſtored with theſe ſubterraneous trees, but likewiſe all the marſhes along the river ſide, for ſeveral miles; for theſe trees are found all along the *Thames*, over againſt *Rainham*, *Wennington*, *Purfleet*, &c. and in the breach that happened at *Weſt Thorrock*, about 21 years ago, they were waſhed out in as great numbers, and of the ſame kind of wood, as thoſe found in *Dagenham* and *Havering* levels: Theſe laſt are of different ſizes; ſome upwards of a foot in diameter, and ſome leſs; Mr. *Derham* ſaw two of the leſſer ſort, ſtanding upright, in the ſame poſition wherein they grew; their tops juſt above low water and their bottoms, at leaſt the bottom of the channel, at 16 foot depth; they could not be pulled out, and they ſeemed to be about two inches diameter in their trunk, with ſome of their boughs on: Moſt of the trees had their roots on, and ſeveral of them their boughs, and ſome a part of their bark; there was only one that he perceived had any marks of the ax; and its head had been lopped off: Mr. *Derham* ſaw all along the ſhores, as he paſſed the channel, that the water had torn up a vaſt many ſtumps of thoſe ſubterraneous trees, remaining in the very ſame poſition in which they grew, with their roots running, ſome downwards, others branching and ſpreading about in the earth, as trees that grow are commonly obſerved to do: Mr. *Derham* thought that ſome of theſe ſtumps had marks of the ax, and moſt of them were flat a-top, as if cut off at the ſurface of the earth; but being rotten and battered, he could not fully ſatisfy himſelf, whether the trees had been cut or broken off: The ſoil wherein they grew, was a black ouzy earth, full of reed-roots, on whoſe ſurface the trees lay proſtrate, and over them a covering of grey mould, of the ſame colour and conſiſtence with the dry mud, which the water leaves behind it at this day; this covering of grey earth is about ſeven or eight foot thick; in ſome places 12 foot or more, and in others leſs; at which depth the trees generally lie: What was next obſervable was the poſition, wherein the trees lay; which indeed was not regular, ſome lying one way and ſome another, and ſeveral of them a-croſs; only that in one or two places, they lay more regularly with their heads for the moſt part towards the north, as

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if they had been blown down by a ſouthерly wind, which exerts a pretty ſtrong force on that ſhore.

As to the age in which theſe trees were interred, it is hard to determine: Several are of opinion that they have lain in that ſubterraneous ſtate ever ſince *Noah*'s flood; but tho' Mr. *Derham* does not in the leaſt doubt, that at this day we have ſeveral remains of the ſpoils of that deluge, even on the higheſt mountains; yet he rather inclines to think, that theſe trees are the ruins of ſome later age, by ſome extraordinary inundations of the *Thames*, or by ſome ſtorms, which blow ſharply on this ſhore; either way trees growing in ſo looſe a ſoil as theſe manifeſtly grew in at that time might be ſoon rooted up and beat down; and as to extraordinary inundations of the *Thames*, there is at this day a mark, which if occaſioned by an inundation muſt have been that of a very prodigious one, beyond any ever known to have happened in that river; to wit below a bed of ſhells, if not alſo a ſort of marle, lying croſs the highway, on the deſcent near *Stifford-bridge*, in going from ſouth *Okendon*, at upwards of 50 or 60 yards diſtance, in the bottom of the valley there runs a brook that empties itſelf into the *Thames* at *Purfleet* about three miles from thence, and ebbs and flows as the *Thames* does, but not at any certain height, by reaſon of mills, that ſtand thereon; but above a pretty high-water in the brook, Mr. *Derham* found the ſurface of the bed of ſhells to lie upwards of 20 foot perpendicular; conſequently, if this bed of ſhells was repoſited in that place by an inundation of the *Thames* it muſt have been ſuch, as would have drowned a vaſt deal of the adjacent country, and over-topped the trees by the river in *Weſt Thorrock*, *Dagenham*, and the other marſhes; and probably by that means have overturned them: Now had theſe trees been left there by the univerſal deluge, we ſhould not find a bed of earth, wherein they grew, ſo entire and undiſturbed, as it manifeſtly is, a ſpongy, light, ouzy ſoil, full of reed-root; and, tho' Mr. *Derham* never tried it, he was perſwaded it was of much leſs ſpecific gravity than the layer over it; whereas he could from experiments affirm, that in three places, where he tried it, the *Strata* were in a ſurpriſing manner gradually ſpecifically heavier and heavier, the lower they lay.

As to the manner how theſe trees came to be interred; this he takes to be from the gradual encreaſe of the mud, which every tide the *Thames* left behind it: He preſumes, that theſe trees might have been thrown down, before the walls, or banks were made, that keep the *Thames* out of the marſhes, and then they were

were covered every tide; and by reaſon they lay thick, they would ſoon gather a great deal of the ſediment or mud; and after the ſaid walls were made, every breach in them, and inundation, would leave behind it large quantities of ſediment, as Mr. *Derham* found in going over ſome of the marſhes, ſoon after this breach; where he found the mud generally above his ſhoes, and in ſeveral places above his knees; and it is a practice among us (of which there are divers inſtances) that where a breach would coſt more to ſtop it, than the overflown lands would countervail, there to leave the lands to the mercy of the *Thames*; and theſe lands gradually growing higher and higher, by the additions of ſediment, will in time ſhut out the water of the river, all excepting the higheſt tides, and theſe lands they call ſaltings, when covered with graſs; or elſe they become reed-ground, *&c.* That it was the ſediment, or mud of the *Thames* that buried theſe trees, is farther manifeſt from what is ſaid above, of the likeneſs of the ſoil over them, in all reſpects to the ſediment the river now let's fall, when dry; which may be obſerved to conſiſt of ſeveral diſtinct layers; ſome two tenths of an inch thick, ſome leſs, and others ſcarce one thirtieth of an inch; all which ſeveral layers are, doubtleſs, the ſeveral quantities which each tide left behind it: This ſediment when dried by the ſun and wind, becomes tough and hard, and looks like a grey *Lapis ſciſſilis*, or ſlate, and diviſible into the ſeveral *Laminæ* or plates; and probably we might aſcribe the conformation of ſlate, muſcovy-glaſs, and other ſimilar laminated concretions, to a like work of nature, by an addition of new layers of ſuch petrifactions, and particles, as the foſſil is formed of: That the ſubterraneous wood receives its blackneſs from vitriolic juices in the earth, appears by experiment; for Mr. *Derham* found that alder-wood, whether green, or old, becomes blackiſh in a ſolution of copperas; which is not only an argument, that the blackneſs of the wood is owing to vitriol, but alſo that the wood is alder, or ſome ſuch like wood, that will become black with vitriol; for, Mr. *Derham* was informed, that all ſubterraneous wood, is not black, particularly fir: He afterwards tried horn-beam in the ſame manner, and found that that alſo becomes black.

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Experiments and Obſervations on the Effects of ſeveral Sorts of Poiſons on Animals, at Montpelier; *by Mr.* Courten. Phil. Tranſ. N° 335. p. 485.

IN *July*, 1678, we gave a dog a piece of bread ſteeped in two ounces of *Solanum Batavicum*, Dutch *nightſhade*, expreſſed from the green plant, and mixed with cheeſe; as far as we could perceive, the dog did not ſeem to receive any manifeſt damage from it: The ſame doſe of the juice of the leaves of *Cicuta*, or *hemlock* had no greater effect upon him; we alſo gave the ſame dog a pretty large root of *Aconitum Paralianches*, *wolf's-bane*, together with the leaves and flowers of the ſame plant bruiſed, and mixed with fleſh, which did him no hurt: Two drachms of *Helleborus albus*, *white hellebore*, diſordered him very much, cauſing reachings, ſuffocations, vomiting, and voiding of excrement; this dog, (as afterwards we often obſerved in others that had taken the like corroſive medicines) whether becauſe he was not able to endure the pain, or by reaſon of any other uneaſineſs, often ſcratched the ground with his feet; however, he recovered, and did well again: He alſo ſwallowed five roots of *Colchicum Ephemerum*, *meadow-ſaffron*, dug freſh out of the ground, with which he was violently tortur'd, but did not die: At laſt he took two drachms of *Opium*, which caſt him into a deep ſleep; but after vomiting and voiding fœtid excrements, he recover'd by degrees his former briſkneſs; ſo many, and theſe ſo notorious poiſons, could not kill this dog. Some weeks after, when the ſame dog had recovered his former vigour, we tried on him the force of a much ſtronger poiſon; for, we cauſed him to be bit by an enraged viper three or four times on the belly, a little below the navel; and there immediately aroſe little black bladders, containing a liquid blackiſh ſort of corruption; they were flaccid, and tremulous, like the gall-bladder when about half full, and a livid colour by degrees overſpread all the neighbouring parts; the venom propagated itſelf with ſurpriſing quickneſs, and weakened all, but more eſpecially, the animal functions; for, notwithſtanding the diaphragm ſtill performed its office pretty ſtrongly, tho' with ſome diſorder, and the heart continued beating, tho' faintly and irregularly; yet they ſeemed to fare much better than the brain, whoſe ſtrength was weakened in ſuch a manner, that it could not perform the functions of ſenſe and motion but very faintly; inſomuch, that the dog lay without any ſtrength or ſenſation,

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as if he had been ſeized with a lethargy, or apoplexy; which kind of ſtupidity we alſo obſerved, ſometimes in a greater, and ſometimes in a leſs degree, in all other dogs, bit by a viper; but being willing to ſave this dog, (tho' we had found by ſeveral experiments, that much ſlighter wounds made by a viper had occaſioned death) we had recourſe to ſeveral remedies; and therefore, cupped and ſcarified the part that was wounded, and applied *Theriaca, treacle*; afterwards we let him alone for about two hours; but his ſleepineſs increaſing more and more, and his vital and animal functions ſinking, we were obliged to have recourſe to another method of cure; wherefore, to diſpel his ſleepineſs, we forced into his throat half a drachm of volatile ſalt of hart's-horn, mixed in broth; in a little time after, his eyes, which before looked dead, began to revive, and he could ſtand on his feet and walk; whereupon, we repeated the ſame doſe of the volatile ſalt, and by it he was freed from his ſleepineſs, and the vigour of his heart recovered, tho' he would not eat any thing all that time; but he drank water very plentifully, and greedily, and on the ſecond day did not refuſe cold broth; after the third day, he began to eat ſolid meats, and now he ſeemed to be out of danger; only ſome large foul ulcers remained on that part of his belly, that was bit, of which he would ſcarce have died, had he not been killed by another dog, which prevented us from ſeeing the event of this experiment.

But to try more fully the force of the above-mentioned poiſon, it is neceſſary to make ſeveral experiments of it: for, tho' the bite of a viper, if it be but ſlight, may kill ſome dogs; yet the following month, a large ſtrong dog, that was bit in the tongue, which is a very dangerous part, recovered without any medicines; his tongue, it is true, turned black, and ſwell'd ſo much, that it could ſcarce be contained in his mouth; he was ſtupid, as is uſual from the venom of a viper, but not ſo much, but that he could ſtand on his feet; a few hours after, his ſleepineſs decreaſed, and the next day he endeavoured to lap water, but the largeneſs of his tongue prevented him; on the third day he threatened to bite any body that diſturbed him, and had recovered ſo much ſtrength, as to be able to eſcape out of the place, where he was kept; and two days after, he was ſeen in the ſtreets, but what became of him afterwards we could not learn.

On the 17th of *October* we gave a dog fifteen grains of the dried root of *Napellus, monks-hood*, powdered, and mixed with

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flesh and broth; he had no sooner taken it, but he was seiz'd with a difficulty of swallowing, or rather seemed as if he was like to be suffocated; he immediately became faint and restless, and dug the ground with his feet; but he soon desisted, by reason of a fainting fit, as we supposed from the dulness of his eyes, and a weakness over all his body; this fainting was presently succeeded by a violent vomiting, in which he threw up the flesh he had eaten, very little altered; his fainting soon returning again, he laid himself on the ground; but, being seized with terrible convulsions of the *Abdomen*, diaphragm, and almost the whole body, he ran from place to place, and vomited so great a quantity of frothy matter, that he was like to have been suffocated; his vomiting increased, with a kind of crying and sobbing, like broken sighs, as if he endeavoured to bark at those that stood by; in this manner he was miserably tormented for the space of an hour, at which times all his symptoms remitted, and he recovered by degrees: In the preceeding summer, we gave a little dog a drachm of the said *monks-hood*; he was soon after seised with the same symptoms, but they were longer and more violent, and he in like manner recovered: In both these dogs we particularly took notice of these broken, and interrupted sighs, or kind of sobbing; because, we had not observed the like to be occasioned by any other poison we made trial of: An ounce of the leaves, flowers, and seed of *monks-hood*, when green, being bruised, and given to a dog, scarce disordered him any more than if he had eaten so much grass: About the same time we made trial of the *Nux vomica* on another dog, in order to see its effects on his body when dead; accordingly, the dog dying in a short time, we found his stomach and thin guts very red, and judged, that this redness, and inflammation, was caused by the corrosiveness of the medicine.

On the 20th of *October* we injected warm into the jugular vein of a strong lusty dog an ounce of emetic wine; for a quarter of an hour, after the operation was over, and he was let loose, he continued pretty well, only that he seemed somewhat dejected; but afterwards he began to grow ill, and an unusual agitation was manifest about the diaphragm; this was followed by a continual vomiting, and a little after by an evacuation of some hard *Fæces*: by these evacuations he seemed to be somewhat relieved, but he soon grew uneasy, mov'd from place to place, and vomited again; afterwards he laid himself down upon the ground pretty quietly; but his vomiting

miting, returning again, disturbed his rest, and abated his strength, which became weaker and weaker; for, in the space of an hour, he vomited upwards of twelve times, and sometimes voided some liquid *Fæces*, but in small quantity, having frequent inclinations to go to stool, but to no purpose, as in a *Tenesmus*; an hour and a half after the operation, he being so weak that he could not stand, his eyes dull, and looking, as if he were half dead, we gave him some warm broth thro' a funnel; with this he was exceedingly refreshed at once, and soon after could look about, stand on his legs and walk; but, by reason of his weakness, reel'd, as if he had been drunk; we left him by himself in a warm room, where he remained cold, and lay as if he had been dying; and in an hour after, we forced him to take some more broth, which revived him again; but in a little time, after some agitation of his body, he vomited, made urine very plentifully, howl'd miserably, and died convulsed; next day in viewing his *Viscera*, we found two things very observable (but neither of them occasioned by the injected liquor) one in the heart, and the other in the *Oesophagus*; in the heart there were two *Polypus*'s; that, which possessed the right ventricle, extended itself into the *Cava*, and pulmonary artery; and that in the left ventricle, sent branches into the adjoining vessels, and was less than that in the right; the substance of the *Polypus* was pretty firm, of a flesh colour, somewhat pellucid, and being cut thro' the middle, was altogether of the same colour, and consistence, as on the surface; to the *Oesophagus* there grew a remarkable gland, which was hard, callous, and foul, and opened with a small, round, fleshy orifice, into the inside of the stomach, where, upon pressing it, there issued a little purulent matter; upon opening this gland, or tubercle, we found therein a great many little worms, wrapped and intangled together, and moistened with a purulent matter; some of these worms were upwards of four inches long, others less; we found afterwards, in other dogs, and that in most we opened, the like glands full of worms, but not so much corrupted as in this; we also observed the like foul glands in the *Aorta descendens*, but only in one found a worm like these, which was almost got out of it, thro' an orifice, into the cavity of the *Thorax*; after this, we likewise observed more *Polypus*'s in dogs: On the 27th of *October* we injected warm into the jugular vein of a dog, a drachm and a half of sal armoniac, dissolved in an ounce and a half of water; the liquor had scarce arrived at the

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the heart, but presently the dog fell into mortal convulsions all over his body; wherefore, we let him loose, but he died immediately: On the 18th of *November* we caused a whelp to be bit in the lower lip by a *Cæcilia*, or *blind-worm*, so that the blood appeared in the wound; the whelp, it is true, died the same day; but we could not be positive, whether he died (being committed to the care of another person) of the wound or not; and what increased our suspicion was, that there did not appear on the part that was bit, any livid colour: On the 12th of *December*, we injected into the jugular vein of a dog a drachm of salt of tartar, dissolved in an ounce of warm water; he died crying, and in convulsions, almost immediately: On the 15th of *December* we found a *Polypus* in both the ventricles of the heart of a dog, each *Polypus* stretching itself with a double root into the vessels of the ventricle it possessed; afterwards we often observed the like *Polypus's* in other dogs: On the 20th of *December*, we injected warm into the jugular vein of a dog, an ounce of urine, made by a man fasting; the dog was uneasy during the injection, and while the liquor passed to the heart, but was not seised with any convulsions, or other bad symptoms, and being let loose, he eat bread very greedily: The same day we made a gentle decoction of two drachms of *white hellebore*, well powdered, in spring water, and evaporating it to nine drachms and a half; and next day we injected all the decoction, strongly pressed out and turbid, into the jugular vein of a dog; at first some few drops only passed to the heart, some concreted blood obstructing the passage, but these drops very much affected the dog; for, he was immediately seised with convulsive motions: But soon after, when the liquor had removed what lay in its way, and had entered the heart, it kill'd the dog as suddenly, as if he had been shot thro' the heart with a bullet; for, having loosened him presently, to see if any life remained, he was quite dead and flaccid, and hung like a fleece in the hand of the person that held him. On the second of *January*, 1679, vinegar was injected warm into the jugular vein of a dog, without doing him any manifest harm: The same day we caused a whelp to be stung by several scorpions, but the wounds being but slight, and not penetrating deep, we made a small incision on the *Abdomen*, and drawing the skin aside, let the scorpions make several wounds on it, but without any effect; tho' we often forced the sting into the wounds, and pressed the bladder that is supposed to contain

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the venom: In like manner a pidgeon, being ſtung ſeveral times by a ſcorpion, remained unhurt. *January* 3d, two drachms of ſugar, diſſolved in an ounce of water, was injected into the jugular vein of a dog; he received no harm from the injection, but continued well for three days after that we kept him: On the fourth of *January*, a drachm and a half of the ſpirit of ſalt, diluted in an ounce and a half of water, and injected into the jugular vein of a dog, killed him immediately; in the right ventricle of the heart, we found the blood partly grumous, and concreted into harder clots than ordinary, and partly frothy; in the ſame dog, that gland that contains worms, and is frequently found in the *Oeſophagus*, opened with two orifices into the cavity of that part, and in its *Sinus*'s there lay ſeveral ſmall worms: *January* the fifth, we gave a dog twelve ſmall caterpillars of the pine-tree, or *Cityocampæ vel Erucæ pini*, weighing half a drachm, which we bruiſed alive, and mixed with fleſh; the dog, tho' he was but young, received no other hurt, than that now and then he ſeemed, as if he endeavoured to ſwallow ſomething, or troubled with an inclination to vomit; whence we judged, that the ſtomach and *Oeſophagus* were only ſlightly affected, but theſe ſymptoms vaniſhed in a few hours, and the dog continued briſk, and greedy of meat all the reſt of the day: The ſame day we included a rat in a large glaſs with a ſcorpion; but the ſcorpion being dull, and benumbed with the extreme coldneſs of the weather, could wound the rat but very weakly; with which, however, the rat being provoked, ſet upon the ſcorpion, and gnawed off, and devoured part of him, keeping his eyes ſhut all the while, that he might not be hurt by his claws, or ſting; the ſame fate happened to another ſcorpion, which we added to the former; but the rat ſtill remained unhurt: *January* the ſixth, we killed a dog almoſt in a moment, by injecting into his jugular vein an ounce of ſpirits of wine, wherein was diſſolved a drachm of camphire: The ſame day, we injected warm, into the crural vein of a cat, fifty grains of *Opium*, diſſolved in an ounce of water; the cat, preſently after the injection, ſeemed very much dejected, but did not cry, only made a low, interrupted, whining noiſe; after this followed tremblings of her limbs, convulſive motions of her eyes, ears, lips, and almoſt of all the parts of her body, with violent convulſions of her breaſt; ſometimes ſhe would raiſe her head, and ſeem to look about her, but her eyes were very dull and deadiſh; and tho' ſhe was let looſe,

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and had nothing tied about her head, or neck, yet her mouth was filled with foam, or froth in ſuch a manner, that ſhe was like to be ſuffocated; at laſt her convulſive motions continuing, and being ſeiſed with a ſtretching of her limbs, ſhe died within a quarter of an hour after; upon opening her body, we did not find the blood much altered from its natural ſtate: *February* the 7th we injected into the crural vein of a luſty ſtrong dog, a drachm and a half of *Opium*, diſſolved in an ounce and a half of water; the dog immediately ſhewed the great pain he endured, by a violent ſtruggling of his whole body, a loud noiſe that he made, notwithſtanding his jaws were tied, a great difficulty of breathing, and a palpitation of the heart, with convulſive motions of almoſt all the parts of his body; in a little time all theſe remitted, and he was ſeiſed with a profound ſleep, as if he had been in a lethargy, or apoplexy; upon letting him looſe, he lay upon the ground without moving, or making a noiſe, in ſo deep a ſleep, that he would not move without beating; about half an hour after, if we beat him, he would move a little, but preſently lye down again; an hour after that, if we beat him, he would move a little more; and by degrees his ſleepineſs decreaſing a little, in an hour and a half, or two hours time, when he was beat, he would make a noiſe, and walk a little, but ſeemed very heavy and ſtupified, and reeled as he went; but as ſoon as we left off beating him, as if he had forgot every thing that had paſſed, he preſently laid himſelf down again, and fell aſleep; next day when we viewed the place where he lay, we found a great quantity of fœtid excrement, like corrupted blood, or the diluted *Opium*, that had been taken; but ſtill his drowſineſs continued and tho' we beat him with whips, that he ran crying about the room, yet he would preſently forget, and immediately fall aſleep again; in this ſleepy condition he continued three days, refuſing whatever was offered him to eat, or rather not minding that for any thing elſe; on the fourth day we found him dead; but perhaps he would not have died of the ſtupifying quality of the *Opium*, if conſidering the extreme coldneſs of the weather, we had put him into a warmer place, and forced him to have taken ſome broth: *February* the 8th, we found in the bladder of a tortoiſe, adhering to its coat, a flat porous ſtone, about twice as big as a lentil: *February* the 9th, a drachm and a half of common ſalt, diſſolved in an ounce and a half of water, was injected into the jugular vein of a dog; after the injection, he was thirſty, and drank water greedily; but in other reſpects he ſeemed to be pretty well, and next day he

he entirely recovered: *February* the 20th, 1679, we injected into the crural vein of a little dog, half an ounce of warm oil of olives; which we did with a great deal of difficulty, and very slowly, by reason of the smallness of the vein, and thickness of the liquor; for half a quarter of an hour that we were injecting the liquor, the dog did not seem to be uneasy, or out of order; but afterwards, he barked, cried, looked dejected, and presently fell into a deep apoplexy, so that his limbs were deprived of sense and motion, and flexible any way at pleasure; his respiration still continued very strong, with a snorting and wheezing, and a thick watry humour, flowing plentifully out of his mouth, which was sometimes mixed with blood; he lost all external sensation; his eyes, tho' they continued open, were not sensible of any objects that were presented to them; and we touched, and rubbed the *Cornea*, without any more signs of his being affected, than if he had been dead; his eyelids, notwithstanding had a convulsive motion; his hearing was quite lost; and his feeling, tho' at first he seemed to have some small sense of it, when we touched his wound, yet afterwards it was so dull, that we pinched his claws, and flesh with pincers, and bored holes thro' his ears, without his moving, or seeming to be in the least sensible of it: It is observable, that in the midst of his sleep, being sometimes seised with a convulsive motion of his diaphragm, and the other muscles, that help respiration, he would bark strongly, as if he were awake, and in a little time be quiet again; so that in less than a quarter of an hour his rest would be disturbed three or four times with this violent barking; and considering this more attentively, we found that at the very time he barked, he was as void of sense as before; for we could neither make him bark, nor leave off barking, by either beating or pricking him; but in a little time would leave off of himself, and return to it again some time after: Thus in three hours after the injection, spent in sleeping, and barking, he died; and opening his body, after he was dead, we found the *Bronchia* of the lungs filled with a thick froth: A few days after we injected an ounce of oil of olives into the jugular vein of a dog, which suffocated him the same moment: Afterwards the same quantity of oil of olives being injected into the jugular vein of a dog, killed him in an hour's time; he was seised with a great sleepiness, snorting, and wheezing, and a bloody water run plentifully out of his mouth; we did not observe in this dog, tho' he did not die immediately, the barking, as in the former; but in all that were suffocated by oil, we found their lungs filled with a very

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very thick froth: *February* 27th we injected 10 drachms of highly rectified ſpirits of wine into the crural vein of a dog; the dog died in a very little time, very quietly, and with pleaſure as it were, licking his jaws with his tongue, and breathing quick, but eaſily, without barking, crying, or any convulſive motion: The blood was concreted into a great many liquid hard clots in the *Cava*, and right ventricle of the heart; this appeared ſtill more conſpicuous, and harder in ſome blood, that flowed back from the vein into the ſyringe; we found the emulgent artery of the left ſide in this dog to be double: *March* the 2d we injected three drachms of rectified ſpirits of wine into the crural vein of a ſmall dog, which made him apoplectic, and as if he were half dead; in a little time he recovered from his apoplexy, but grew giddy; and when he endeavoured to go, reeled, and fell down; tho' his ſtrength increaſed by degrees, yet his drunkenneſs ſtill continued; his eyes were red and fiery, and his ſight ſo dull, that he did not ſeem to take notice of any thing, and when beat, would ſcarce move; however in four hours time he grew better, and would eat bread when we gave it him; the next day he was briſker, and ſeemed to be paſt all danger: In diſſecting the ſame dog ſome time after, we found in the thin guts two flat worms, one of them about ſix ſpans long, and the other above five; they had perforated the gut, and one of them was got half out of it into the cavity of the *Abdomen*: About the ſame time we found in two dogs a worm of near a foot long, out of the inteſtines, in the cavity of the *Abdomen*, the inteſtines being no ways perforated, but remaining ſound and whole, and in order to be the more aſſured of this, we ſeparated them from the meſentery, and viewed them very carefully; but in both theſe dogs the *Omentum* was of a bad colour, and putrefied; whence we conjectured, that theſe worms were bred from the putrefaction of the *Omentum*: We injected into the crural vein of a dog five ounces of a ſtrong white wine, which made him very drunk, and little different from what a leſs quantity of ſpirits of wine would have done; but in a few hours his drunkenneſs abated, and he recovered: In the ſame month of *March* we injected into the crural vein of a dog, an ounce of a ſtrong decoction of tobacco; he was ſeiſed immediately with ſtrange convulſions of his whole body; at firſt his eyes looked wild, and diſtorted, his jaws trembled, and in a little time he died terribly convulſed; this experiment we repeated ſeveral times afterwards, and always with the ſame ſucceſs: Ten drops of diſtilled oil of ſage, mixed with half a drachm of ſugar, and diſſolved in an ounce

ounce of water, being injected into the crural vein of a dog, did him no harm: In a castrated dog, we observed the processes of the *Peritonæum*, and spermatic vessels to be covered with fat, and scarce visible; and that he did not smell so rank, and strong as other dogs, that had not been castrated: A yellow streaked *Lizzard*, or *Lacerta Chalcidica*, which had been kept all winter in a glass with bran, being exposed to the sun to refresh it, died in a few hours; he also often found, that scorpions exposed to the hot sun, especially in the summer, died in a short time: A drachm of purified *White Vitriol*, injected into the crural vein of a dog, killed him immediately: Fifteen grains of salt of urine, dissolved in an ounce of water, and injected into the crural vein of a dog, cast him into such violent convulsions, that we were afraid he would die under them; when he had recovered himself a little, we repeated the injection with the same quantity; but the dog got the better of it, tho' with a great deal of difficulty, and he perfectly recovered: *April* the 27th we made a decoction of two drachms of *Senna* in water, and injected warm three ounces of it into the crural vein of a very fat, large, and strong dog; he continued pretty quiet, without any sign of pain, or uneasiness, during the operation; and when it was over, we let him loose, expecting the event of it; he was melancholy and dejected, but easy, and without any sensible commotion for the space of an hour; afterwards his respiration grew quicker, he had a murmuring noise in his belly, with violent commotions of the muscles of the *Abdomen*, diaphragm, stomach and intestines, and vomited plentifully a bilious matter; after his vomiting he grew faint, and in a little time his vomiting returned again; so that in an hour and a half he vomited four times; his strength and appetite were very weak, and he would eat nothing for three days; but on the third day his appetite, strength, and former briskness returned, and he recovered: Two dogs, that had their recurrent nerves cut, lost their barking, and voice; but doubting, whether the wound, or scar might not affect, and hurt the motion of the muscles, we performed the same operation on another dog, but without cutting the nerves; and when the wound was healed, he barked as freely as before: A dog that had the nerves of the *par Vagum* cut asunder, presently grew dejected, and faint; he breathed very slowly, and with sighs; for when he had drawn in his breath leisurely, and insensibly, it immediately came forth again very forcibly, and with a sigh, as if it had been retained a long time in the lungs; the muscles of the *Abdomen* and diaphragm laboured

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laboured hard, as if they were to ſupply the defects of the lungs, which were become almoſt uſeleſs by being denied an influx of ſpirits by the pneumonic nerves; the dog refuſed all kind of meat; ſometimes he vomited, or had an inclination to vomit; and at laſt, in two days time, he died: Another dog, that had the nerves of the *Par vagum* only tied, lived 10 days; he vomited frequently, and would not eat, unleſs clandeſtinely; he breathed with ſighs, and was very faint: A dog that had the trunk of the deſcending *Aorta*, tied hard a little above the diaphragm, immediately loſt the uſe of his hinder legs; for when he ſtood on his fore legs, he would draw his hinder legs after him, as if they had been dead; he became weaker by degrees, and died in five hours: *July* the 12th, a mole being ſtung in the ſide by a ſcorpion, died immediately convulſed; by this ſubject we obſerved, that the *Cæcum* is wanting in moles.

Obſervations in Natural Hiſtory *in* Wales; *by Mr.* Lhwyd. Phil. Tranſ. N° 335. p. 500.

IN a ſteep rock called *Craig y Park*, and others in the pariſh of *Yſtrad Dyvodog*, we obſerved divers veins of coal, expoſed to ſight, as naked as the rock; and found a flint ax, ſomewhat reſembling thoſe uſed by the *Americans*: At *Goldcliff* in *Monmouthſhire* we found ſeveral formed ſtones; but what pleaſed Mr. *Lhwyd* moſt, was an *Aſteria*, or column ſtar-ſtone, beſet with ſprigs its whole length, iſſuing from the commiſſures of the plates: This county abounds in *Entrochi*, one of which he ſaw in a rock in the iſle of *Barry*, upwards of 15 inches long, and another about 10 inches long, but as thick as a cane, which could not be got off without breaking: At *Kaerphily* caſtle the people ſhewed us an inſcription, as they ſuppoſed, on one of the ſteps of the tower; Mr. *Lhwyd* was not fully ſatisfied, whether it were ever deſigned for reading, or for ſome kind of antique ornament; but he rather inclines to the latter; the ſtone was not deſigned for a ſtep, there being none of the ſame kind in the whole ſtair-caſe; the marks were moſtly effaced by treading; and it is poſſible, that they might be once more uniform: He ſent the ſtone to the *Muſæum* at *Oxford*; were it the old *Celtic* character, which *Cæſar* ſays was like the *Greek*, it were a noble diſcovery, but that Mr. *Lhwyd* ſuſpects his anceſtors the *Britons* (if ever they had any writing) have left none upon ſtones.

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Obſervations on the Natural Hiſtory *and* Antiquities *of* Ireland; *by the Same.* Phil. Tranſ. N° 335. p. 503.

IN our way towards the *Giants Cauſeway* in *Ireland*, the moſt remarkable curioſity we ſaw was a ſtately mount at a place, called *New-grange* near *Drogheda*, with a great many huge ſtones, pitched on end round about it, and a ſingle ſtone on the top; one Mr. *Campbel*, the gentleman of the village, obſerving, that under the green turf, this mount was entirely compoſed of ſtones, employed his ſervants to carry off a conſiderable parcel of them, till at length they came to a very broad flat ſtone, rudely carved, and placed edgeways at the bottom of the mount; this they diſcovered to be the door of a cave, which had a long entry leading into it; at the firſt entering we were obliged to creep, but ſtill as we went on, the pillars on each ſide of us were higher and higher, and coming into the cave we found it about 20 foot high; in this cave on each hand of us, there was a cell, or apartment, and another went on ſtrait forwards, oppoſite to the entry; in thoſe on each hand there was a very broad ſhallow baſon of ſtone, ſituated at the edge; the baſon in the right hand apartment ſtood in another; that on the left hand was ſingle, and in the apartment ſtrait forwards there was none at all; we obſerved water drop into the right hand baſon, tho' it had rained but little for ſeveral days, and we ſuſpected, that the lower baſon was intended to preſerve the ſuperfluous liquor of the other (whether this water were ſacred, or whether it was for blood in ſacrifice) that none might come to the ground: The large pillars round this cave, ſupporting the mount, were not at all hewn, or wrought, but ſuch rude ſtones, as thoſe of *Abury* in *Wiltſhire*, and rather more rude than thoſe of *Stonehenge*; but thoſe about the baſons, and ſome elſewhere, had ſuch rude ſculpture (*viz.* ſpiral like a ſnake, but without diſtinction of head, or tail) as the above-mentioned ſtone at the entry of the cave; there was no flagging, nor floor to this entry or cave, but all looſe ſtone every where under foot; they found ſeveral bones in the cave, and part of a ſtag's or elk's head, and ſeveral other things: A gold coin of the emperor *Valentinian*, being found near the top of this mount, might beſpeak it *Roman*, did not the rude carving at the entry ſeem to denote it a barbarous monument; ſo that the coin proving it more ancient than any invaſion of the *Oſtmans*, or *Danes*, and the carving, and rude ſculpture, barbarous, it ſhould follow, that it was ſome place of ſacrifice or burial of the old *Iriſh*: As to the *Giants Cauſeway* vide *Phil. Tranſ.*

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Transf. N° 212, 241. We have the ſame ſtone on the top of *Cader Idris*, one of the higheſt mountains of north *Wales*; but ours is leſs elegant, and does not at all break off in joints; nor could Mr. *Lhwyd* ſatisfy himſelf that there are ſet joints, as in the *Entrochus* and *Aſteria*, in the *Baſaltes* of *Ireland*; but that it is the nature of the ſtone to break off in ſuch a convex form; however we could perceive no ſeams in theſe pillars, excepting on thoſe ſides that were expoſed to the weather.

Another remarkable curioſity we met with, was a copper trumpet, like a ſow gelder's horn, having the hole for ſounding it near the middle, and two rings at the ſmaller extremity, and it was upwards of two foot long; three of theſe were found in an old *Carn*, i. e. a large heap of ſtones, at *Balle Nivar* near *Carreg Fergus*: We could make nothing of the petrifying quality of *Loch Neach*, only they ſometimes find ſtones there, having the grain of wood: We met with ſome *Iriſh* inſcriptions, which none of the critics in that language we converſed with could interpret: Near *Larne* in *Antrim* we met with one *Eoin Agniw*, whoſe anceſtors had been hereditary poets, or bards for ſeveral generations, to the family of the *O-Neals*, of whom we procured about a dozen ancient M S S. on parchment: The *Mackinboy* is the *Tithymalus Hibernicus*, or *Latifolius Sylvaticus* Cat. Hort. Oxon. their ſhamrug is the common clover: The *Potato* is no native of *Ireland*: The *Arbutus* is the ſame with the common ſort: We had an account of living foſſil muſcles atteſted and ſigned by four perſons preſent at the finding of them.

Experiments *ſhewing the proportion of the Power of the* Loadſtone *at different Diſtances; by Mr.* Francis Hauksbee. Phil. Tranſ. N° 335. p. 506.

MR. *Hauksbee* took a quadrant of four foot radius, and fixing it to the floor, in the poſition of the needle, whoſe ſouth point directed itſelf to no degrees; he then likewiſe fixed a board on the floor, in a direct angle from the ſame; the graduations on the board were three inches diſtant from each other; the needle was ſuſpended on a point, ariſing from the center of the quadrant, from whence the ſeveral ſtations of the magnet were meaſured; the magnet was laid upon a thin piece of board, under which to one ſide was nailed a narrow ſlip of wood, to ſlide it along the ſide of the above-mentioned graduated board, whereby the ſtone might

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be always kept in the same direction to the needle; the stone weighed about six pounds, was rough, and of an irregular figure; yet he could discover no inconveniency in the experiment, arising therefrom, it being, and it acting at all distances in the same position, as first placed on the board; and Mr. *Hauksbee* observed more than once, that the proportions of its power would be regular, and agreeable to the several distances; for when the stone had been differently posited on the above-mentioned thin board, different angles of the needle would ensue at the same stations, yet their proportions to each other would be nearly the same, *i. e.* supposing the stone placed in such a manner, as that at three inches it would give the needle an angle of 90 degrees; the stone being continued in the same direction at the several stations, the proportions of its power to each other would be much the same, as if the angle of the needle at first made but 87, or even but 80 degrees on the quadrant; for upon a small alteration of the poles of the stone, such diversity of angles will arise: In these experiments he made use of two needles, one of a radius of six inches, the other but of one inch; which last, after several trials, he found to be very accurate; besides the advantage it gave in beginning the experiment six inches nearer the stone than the other; and at two foot distance therefrom, it became nearly agreeable to the angles, formed by the long needle at all the farther distances; as appears by the following tables, which were made with the several needles in the same direction of the stone: Mr. *Hauksbee* measured the angles by a silk thread stretched directly over the needle to that part of the quadrant to which it was directed.

It may be observed from the following tables, that the long needle, at nine inches distance from the stone, formed a somewhat larger angle than the short needle at three inches distance from the same; that the short needle, at the distance of nine inches, formed an angle nine degrees less than the long one at the same place; but this odds may easily be accounted for, if we consider the disproportions of the lengths of the needles; for the point of the long needle, at nine inches distance, was brought within an inch as near the stone, as the point of the short needle was, when but three inches distant therefrom; the point of the short needle, at nine inches distance from the stone, was five inches farther from it, than the long one at the same station: These disproportions being considered, it is no wonder, that such difference of angles should ensue upon the use

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uſe of the ſeveral needles near the ſtone; for, at two foot, and the farther diſtances, they nearly agreed, as was ſaid above: Obſerve when he ſpeaks of diſtances from the needle, he always means from its center: It is farther obſervable, that the ſtone at five foot diſtance from the needle formed an angle of two degrees with the one, and of two and a half with the other; yet upon the abſence of the ſtone, they would return to no degrees, as at firſt; which plainly ſhews, that the influence of the ſtone extended farther, tho' obſervations at remoter ſtations, could not eaſily be determined.

Experiments by the ſhort needle.

Diſtances of the loadſtone from the needle in inches.	The ſeveral angles of the needle at the ſeveral diſtances.		The differences compared with each other at the ſeveral obſervations in minutes.
	D	′	Minutes
3	87	00	180
6	84	00	330
9	78	30	570
12 &c.	69	00	735
15	56	45	795
18	43	30	630
21	33	00	540
24	24	00	360
27	18	00	270
30	13	30	150
33	11	00	135
36	8	45	105
39	7	00	90
42	5	30	60
45	4	30	40
48	3	50	30
51	3	20	20
54	3	00	15
57	2	45	15
60	2	30	09

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Experiments by the long needle.

Diſtances of the loadſtone from the needle in inches.	The ſeveral angles of the needle at the ſeveral diſtances.		The differences compared with each other at the ſeveral obſervations in minutes.
	D	′	Minutes
09	87	30	345
12	81	45	570
15	72	15	1135
18	53	20	1100
21	35	00	660
24	24	10	380
27	17	50	280
30	13	10	180
33	10	10	130
36	8	00	90
39	6	30	75
42	5	15	65
45	4	10	40
48	3	30	30
51	3	00	25
54	2	35	20
57	2	15	15
60	2	00	00

At greater diſtances, and even the more remote in theſe tables, the power of the ſtone is ſo weak, and the meaſuring exactly the angles at all times, is ſo difficult, that it is well if we come ſometimes within 10, or 20 minutes of the truth.

The ſtone made uſe of in the foregoing experiments weighed exactly ſix pounds, one ounce and $\frac{1}{4}$ averdupois; its breadth at the north pole was four inches; at the ſouth pole five inches; the length of the ſhorteſt ſide was ſix inches and a half, of the longeſt ſide ſeven inches and a half; its thickneſs at the north pole was one inch and a half, and at the ſouth pole one inch.

The

The ſpecific Gravities of ſeveral metalline Cubes, *compared with their like bulks of* Water; *by the Same.* Phil. Tranſ. N° 335. p. 511.

THESE cubes were ſuppoſed to be extraordinary in their ſeveral kinds, excepting the gold cube; their workmanſhip was very accurate, and exactly of a ſize, tho' they differed a little from our meaſure; ſix of them being laid on a rule, ſide by ſide, meaſured about $\frac{1}{10}$ more than ſix inches; and if their ſides were changed, they ſtill made the ſame meaſure; and it farther appeared, that they were exact, by their agreeing in the weight of their reſpective bulks of water, as may be obſerved, by comparing them in the following table.

Troy Weight

	Weight of the ſeveral cubes in air. O.	PW.	G.	Weight of the ſeveral cubes in water. O.	PW.	G.		In proportion to their like bulk of water.		
Gold	9	11	8	9	00	6 ½		17.	3	
Silver	5	14	10	5	03	10 ½		10.	421	
Copper	4	16	8	4	05	20 ½		8.	841	
Braſs	4	5	7	3	14	9	as	7.	81	ounty
Lead	6	02	12	5	11	17		11.	35	
Iron	4	04	17	3	13	20		7.	777	

An Account of what appeared upon diſſecting the Body *of Mr.* Dove; *by Mr.* Cowper. Phil. Tranſ. N° 335. p. 512.

MR. *Dove*'s body appeared in divers parts of a black, blue, livid, and various colours, before Mr. *Cowper* made any inciſion into it; particularly the back (where the blood was ſettled) had a cadaverous blackneſs, where the *Cuticula* was here and there veſicated, or diſtended with *Serum*; of this there was no appearance before his death; the muſcles of the *Abdomen* had a mortified appearance, being of a blackiſh green colour; the liver was entirely ſphacelated, the ſpleen had large mortified ſpots on its ſurface; both theſe parts were ſpecifically lighter than in their natural ſtate; inſomuch, that portions of each of them ſwam on the ſurface of water, and ſeemed to have more air in them than we commonly find in the lungs in their natural ſtate; the reſt of the *Viſcera* in this lower cavity were not in ſo bad a ſtate, tho' the guts had here and there blackiſh ſpots upon them: The pectoral muſcles were in little better ſtate than

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than thoſe of the *Abdomen*; nor were the intercoſtal muſcles like thoſe of the limbs; Mr. *Cowper* was apt to think that all the muſcles, employed in reſpiration, had more or leſs of this blackiſh appearance; the right lobes of the lungs were diſeaſed, and the ſame ſide of the *Thorax* had a ſmall quantity of *Serum* therein; the lungs on the other ſide were in no bad condition; the heart was very flaccid, and large; the right ventricle and the *Cava* had large *Polypus*'s in them; the pulmonary vein was exceedingly dilated next the baſis of the heart; the left ventricle of the heart had a ſmall *Polypus*, and a great quantity of grumous blood; the great artery was very thin, and appeared much diſtended, with ſome cartilaginous bodies interſperſed in its membranes; in the head, the *Dura mater* was found inſeparable from the *Cranium* in its upper part; a *Polypus* was extracted out of the upper great artery of the brain, called *Sinus falcis ſuperior*; the carotid arteries were very thin, and much larger than in a natural ſtate, before they entered the ſubſtance of the brain: In ſhort, all the blood-veſſels he examined were very much dilated, and ſeemed to be charged with as much wind, as blood.

An Account of a Storm of Hail *in* Yorkſhire; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 335. p. 514.

ON the 7th of *June* 1711, there happened a very great ſtorm of hail, accompanied with terrible thunder, and lightning; it began about *Rotherham* in *Yorkſhire* (a little beyond which there was ſomething of a hurricane) where it burnt a noted tree; about one o'clock it reached *Wentworth-Woodhouſe*; the hail ſtones were from three to five inches in circumference, and ſome ſaid larger, which killed ſeveral pidgeons; but the chief damage done here was to the glaſs windows; in *Waſh* field about two miles from thence, it did vaſt damage; ſome part of the field eſcaped, and the barley received no damage; but moſt of the wheat was cut down, about half a yard from the ground, and the rye about two foot; the ſtubble, tho' green at firſt, turned ſo white, that it looked like a field newly ſhorn; the rye was afterwards mown, inſtead of being ſhorn, and yielded not above a buſhel of corn in a wain-load; ſome of the wheat took root, and grew up; the breadth of this ſtorm was about half a mile, as appeared from its effects; in places adjoining there was no hail, but large drops of rain; one of the hail ſtones being meaſured with a pair of compaſſes, was an inch and a half long; but theſe were not globular, but moſtly oblong;

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oblong; the greateſt part of them at *Bolton upon Dearne* were about the bigneſs of common cherries; tho' one was taken up, that was an inch and a half in diameter, and round, not long, and ſomewhat flat, as the others were; great quantities of twigs, and ſmall boughs were beaten off the trees.

Remarks on the diſpoſition of the Parts, and Microſcopical Obſervations on the Contexture of the Skin of Elephants; *by M.* Leewenhoeck. Phil. Tranſ. N° 336. p. 518.

M. *Leewenhoeck* viewing the hinder part of a female elephant (the largeſt he ever ſaw) in order to obſerve the *Matrix*, he could not diſcover the leaſt appearance of it, which ſeemed very ſtrange to him; but it happened, that as he was narrowly viewing this huge unweildy animal, ſhe made water, but not like other quadrupeds, from whom the water iſſues in a ſtream, as it were; for, from this animal it burſt out all at once, juſt as if any liquor were poured out of a can, ſuddenly turned upſide down; and he obſerved, that the ſkin, out of which the water flowed, was extended, or thruſt outwards about three fingers breadth; and the orifice, or opening of the ſkin in that place, ſeemed to be ſo large, that one might thruſt his fiſt into it; and that part, from whence the water was diſcharged, was not ſituated, as it commonly is in other quadrupeds, under the tail, but in the belly, and very near the place of the navel in other animals: This appeared to M. *Leewenhoeck* to be a particular diſcovery; and the more ſo, becauſe authors affirm that when the time for their copulation comes, the female is wont to prepare herſelf a bed of the boughs of trees, and then caſt herſelf upon her back thereon; but none of thoſe authors give their reaſons for her ſo doing: Caſting his eyes on the fore-legs of the elephant, he obſerved growing on the upper part of the body, or about the breaſt, two nipples, which in cows we call dugs, in a quite contrary poſition to thoſe of mares, cows, &c. whoſe dugs are placed near the hinder legs; but when we conſider the matter farther, we muſt conclude, that nature has ſo ordered it, in relation to the elephant, for the benefit of her young, whom ſhe could not ſuckle, if her dugs had been placed between her hinder legs; for by reaſon of the poſition of the mouth under the trunk, the young elephant cannot ſuck its dam; but the old one ſucks at her own breaſt, and by the help of her trunk conveys the milk into the mouth of the young one: Afterwards, M. *Leewenhoeck* viewed the ſkin of the elephant, which was very rough; and the keeper told him that that roughneſs fell off every year, ſome of which he ſcraped off upon a paper; afterwards

M. *Leewenhoeck* viewed theſe particles of the ſkin, and he always imagined, that moſt of them was a protruded matter, which had not nouriſhment enough to turn it all into hair; and that what became hair was very ſhort, and thin, in proportion to the bigneſs of ſo large a body; and the hair on the tail of the elephant, is much thicker than that on the other parts of the body; but upon viewing theſe particles of the ſkin more narrowly, he diſcovered in ſome of them ſhort ſmall hairs, the roots of which were ſticking outwards in that part joined to the ſkin.

The particles ſcraped off the ſkin of the elephant were crumbled into as ſmall pieces, as are repreſented by A B C D E, Plate XII. Fig. 7. A was a particle on which there had been two hairs, but by the microſcope one might diſcover four: When theſe particles were ſcraped off from the ſkin, ſome of them were thick, and united to each other, as it were, but they were eaſily divided into ſuch particles as are repreſented by the aforeſaid Fig. This annual ſhedding of the matter that is upon the ſkin may be thus accounted for; when the time comes, that there is no increaſe of the hair, but that it is at a ſtand, as it were, as we ſee in other animals that ſhed their hair, the ſame thing happens to the elephant; whoſe hair, as thin, and as ſhort as it is, falls off for the moſt part, and the incruſtrated particles, that ſtick to the ſkin, muſt likewiſe fall of; and theſe particles lay as cloſe to each other, as if they were united, being ſurrounded with flattiſh ſides, as repreſented by C, on which there remained a ſmall particle of hair or wool: Having nicely viewed one of thoſe particles repreſented by Fig. 1. he diſcovered on that ſide which was next the ſkin ſeveral little holes, in ſome of them 8, 10, 15, or more, according to the bigneſs of the particle; but upon viewing the ſame on that ſide, which was fartheſt from the body, the ſaid holes were cloſed up; and he obſerved in ſome few of thoſe particles ſmall hairs ſtanding out, which run into an exceeding ſlender point, agreeing with the hairs of other animals, that are rubbed or cut off.

That he might the better diſcover the figures of the ſaid matter, he attempted to ſlit ſome of the particles with a ſharp knife; but he found them ſo hard, that the knife got notches, and its edge was turned; ſo that he was forced to whet it again, till at length he ſlit ſome to his mind, which he did the more eaſily, after ſteeping them a little while in boiling water; and all that he diſcovered obſervable in diſſecting one of theſe particles was only 25 ſmall ſands which made it ſo hard in cutting, and made notches in his knife.

He

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He took a slice of one of the particles, represented by Fig. 7. which, as he said above, had a great many cavities or holes in it, and placing it before a microscope, he caused it to be delineated, as in F G H I, Fig. 2. tho' it appeared larger to M. *Leewenhoeck*; but he would not pretend to determine, whether these little holes were filled with hairs, when united to the body; nor whether those hairs stuck so fast in the skin, as to remain there upon the separation of the aforesaid particles.

He cut off a slice from another particle, and caused it to be drawn, as represented by K L M N, Fig. 9; and this particle seemed to consist of ten circles, each of which he fancied to be produced at a different time, and perhaps, in a month, according as the matter was protruded from the skin: Upon cutting a slice out of the middle of one of those particles, represented by Fig. 7. he could observe no holes therein, nor upon cutting off any of the upper part could he discover the least of the appearances, represented, Fig. 9. which perhaps was occasioned by the elephant's rubbing, or lying upon those parts.

Observations of the Eclipse of the Moon, Jan. 12. 1711-12, *at* Upminster, *by Mr.* Derham. Phil. Trans. N° 336. p. 522.

THE evening being clear, gave Mr. *Derham* a good opportunity of observing the lunar eclipse; the times are very accurate, and the observations made with an excellent six foot telescope, as follows:

h.	′	″	
6	15		A duskishness upon the north east-side of the moon.
6	36		A thick *Penumbra* upon the moon.
6	37		The *Penumbra* so dense, that it might be taken for the beginning of the eclipse.
6	39		The eclipse undoubtedly begun.
6	41		The shadow so dark, that it nearly hid the moon's north-easterly limb.
7	21		The moon's diameter by the micrometer 1612 equal parts, equal to 31′ 25″.

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h.	′	″	
7	25		The diſtance of the ſhadow from the oppoſite luminous limb of the moon, repreſented by the line *l*, *u*, Pl. XII. Fig. 10. was 1025 parts of the micrometer, equal to 20 minutes.
8	31		End of the eclipſe
8	32		End of the eclipſe very near.
8	32	45	The eclipſe undoubtedly ended.
8	36		A *Penumbra* left.

At the beginning of the eclipſe, Mr. *Derham*'s micrometer happened unluckily to be diſordered, ſo that he could not take with any exactneſs the inclination of the cuſps, and ſome other matters he intended to have obſerved; to ſupply which defect, in ſome meaſure, Fig. 10. repreſents a type of the eclipſe, as well as he could by gueſs; and from the ſame defect he could not warrant the micrometrical meaſures of the moon's diameter, and her eclipſed parts to be otherwiſe than ſomewhat near the truth, perhaps not exactly true; Fig. 10. repreſents the lunar eclipſe; *m*, *i*, *c*, *r*, repreſents the two claſpers of the micrometer, parallel to the equator; N the northern, S the ſouthern part of the moon's diſk, running between the claſpers of the micrometer; *l*, *u*, the enlightened part of the moon, being 1025 micrometrical parts, or 20′.

Father Obſervations relating to the Antiquities, and natural Hiſtory of Ireland, *together with an Account of ſome uncommon Plants about* Penſans *and St.* Ives *in* Cornwall. Phil. Tranſ. N° 336. p. 524.

Ireland affords no great variety of antiquities; Mr. *Lhwyd* procured in divers parts of the kingdom about twenty or thirty *Iriſh* MSS. on parchment; and tho' he conſulted *O'Flaherty*, author of the *Ogygia*, one of their chieſeſt critics, and ſeveral others, they could ſcarce interpret one page of all his MSS. and this is occaſioned for want of a dictionary, which it ſeems none of their nation ever took the trouble to compoſe: What, according to Mr. *Lhwyd*, is moſt valuable amongſt them, is their old laws, which might give ſome light to the curious as to ſeveral of their national cuſtoms, and ſome of their old poems; and all theſe MSS. might be of uſe to any that would compoſe a dictionary of their language, which was anciently (conſidering the narrowneſs of their knowledge,

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as to arts and sciences) doubtless, very copious: the only *Roman* coin he saw was a gold coin of *Valentinian* the younger, formerly mentioned; there were several of our old *English* coins since the conquest; and a cast brass-piece inscribed with *Runic* characters, which he takes to have been a *Danish* amulet: We met with several of our old *British* monuments, call'd *Kaer*, *Karn*, *Cromlech*, &c. and found, that they distinguished them by the same names; what was peculiar to themselves, were their high round towers for belfreys; their round entrenchments, commonly called *Danes Rathes*; and the elf-arrow-heads of flint: About *Sligo* and *Balishani* we found several figured stones, and there we met with variety of *Astropodia* and *Astrorrhizæ*, or *Modioli*, not yet figured nor described, together with other rarities of that kind: In the same neighbourhood, on the mountains of *Ben-Bulben*, and *Ben-Buishgen*, we met with a great many of the rare mountain-plants of *England* and *Wales*, and three or four not yet discovered in *Britain*: Mr. *Heaton's Chamædrys Alpina* is a common plant on these hills, as also on divers other mountains, and heathy grounds in *Connacht* and *Munster*: In the isle of *Aran*, near *Galloway*, we found a great deal of *Adianthum verum*, and a sort of matted *Campion* with a white flower: In most of the mountains of *Galloway* and *Mayo*, there grows an elegant sort of heath, bearing large thyme-leaves, a spike of fair purple flowers, resembling some *Campanula*, and viscous stalks; Mr. *Lhwyd* could not tell, whether it were a species of the *Cisti ladaniferæ*; in the same places *Pinguicula flore carneo minore* is a common plant, and a sort of *Ros Solis*, which he takes not to have been yet described; *Sedum serratum, foliis pediculis oblongis insidentibus* is exceeding common on all the mountainous tracts of *Mayo*, *Galloway*, and *Keri*; on the mountains of *Keri*, *Sanicula guttata* grows in abundance; together with some other rare plants, as the *Arbutus*, *Coryledon hirsuta*, *Cirsium humile montanum cynoglossi folio polyanthemum R. Syn. Alchimilla Alpina pentaphyllos*, *Sanicula aizoides inter guttatam & sedum serratum ambigens*, *Veronica procumbens maxima*; *an N. D.?* &c. We found *Pentaphyloides fruticosa* in great abundance amongst lime-stone rocks on the banks of *Loch Crib* in the county of *Galloway*; and Dr. *Merret's Vaccinia rubra foliis myrtinis crispis*, a very beautiful plant, is no rarity in this kingdom: We met with some marine animals of the exanguious kind, that we never saw before,

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At *Penſans* we met with two or three *Stellæ*, and ſome other *exanguia marina*, which Mr. *Lhwyd* had never ſeen before on our *Britiſh* coaſts; we alſo met, 1. with the *Capillus Veneris verus* in abundance on the ſea-cliffs about *St. Ives*. 2. Dr. *Sherrard*'s *Scrophularia ſcorodoniæ folio*. 3. *Blattaria lutea, an lutea minor Park*? but the leaves of ours were not jagged; as alſo all the plants mentioned by Mr. *Ray* to grow here, excepting the *Gnaphalium marinum*, which ſhould grow here, and two or three more; we likewiſe found ſome *fuci*, which, perhaps, may be new; and Mr. *Lhwyd* was told, that the fiſhermen ſometimes take up the *Corallina marina reticulata* by their hooks.

An Account of Thunder and Lightning in Devonſhire, *by Mr.* Chamberlayne. Phil. Tranſ. N° 336. p. 528.

IN the pariſh of *Sampford Courtney*, near *Oakhampton* in *Devonſhire*, on the ſeventh of *October*, 1711, about three or four a-clock in the afternoon, as the miniſter of the pariſh was officiating, there was ſo great a darkneſs, that he could hardly ſee with ſpectacles; as ſoon as prayers were over, ſome went to ringing as uſual; and ſeveral others ſtanding in the church-porch, a large fire-ball on a ſudden fell in between them, and threw ſome one way, ſome another, but no perſon received any hurt; the ringers ſaid they never knew the bells go ſo heavily, and ſo they were obliged to leave off; and upon looking out of the belfrey into the church, they ſaw four fire-balls a little bigger than a man's fiſt, which of a ſudden broke to-pieces, ſo that the church was full of fire and ſmoke; one *John Goodman*'s ſervant received a full blow on the neck, which made him bleed both at noſe and mouth; but he recovered, and did very well; the fire and ſmoke went up into the tower, and broke a large beam on which one of the bells hung, and the gudging breaking, the bell fell down on the floor; it likewiſe carried away one of the pinnacles of the tower next the town, and threw ſome of the ſtones near a barn-door, at a pretty diſtance from the church, and did ſome damage to one end of the barn; the chimney of the houſe was removed in ſuch a manner, by the thunder and lightning, that every one was ſurprized it ſtood, and did not fall upon the houſe; tho' the people ran about in great conſternation, yet no body received any hurt.

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Microſcopical Obſervations on Muſcles, and the manner of their Production, by M. Leewenhoeck. Phil. Tranſ. N° 336. p. 529.

M. *Leewenhoeck* obſerved, that the ſhell-fiſh called muſcles, lay their eggs on the outſide of their ſhells, and that ſo regularly by each other, that they may be compared to a ſtring or band; theſe eggs, or imperfect muſcles, lying on the ſhells, do continually increaſe in ſtrength, till at laſt they come to be perfect muſcles; but then you may obſerve ſticking faſt on the ſhells a part of the egg-ſhell, till the ſkin, or membrane, wherewith the muſcles are encompaſſed, be changed: In *Auguſt* 1710, he procured ſome muſcles, and diſſected them, as well as he could; and he found within the ſhells, on both ſides of the muſcle, againſt the parts of the fiſh, very thin, and weak membranes, which he had often taken out of the muſcles, and placing them before a microſcope, he obſerved ſuch a vaſt variety of motions therein, as could not be deſcribed; and this he likewiſe ſhew'd to ſeveral others; and thoſe appearances he obſerved, not only in one, but in all the muſcles he diſſected, eſpecially ſuch as had not been long out of the water; theſe muſcles do not lie ſingle, but are at leaſt three upon each other, being compoſed of longiſh fibres; and each fibre has on both ſides a vaſt many moving particles; theſe fibres are not extended lengthways, but in breadth, and each of them provided with a great many joints; inſomuch, that M. *Leewenhoeck* reckoned twenty five joints in one of them, in the broadeſt part of the membrane; and they lay as regularly, and joined to each other, as the little bones that ſhoot out on both ſides of the back-bone of a fiſh: He placed before a microſcope a ſmall particle of the above-mentioned membrane; and tho' that particle was not the 100th part ſo big as a common grain of ſand, yet he diſcovered a vaſt variety of motions therein, which were not only circular, but he could diſcover at leaſt fifty ſlender particles in the length; which appeared thro' the microſcope of an equal ſize with ſix hairs breadth, and the thickneſs of one hair, as they appear to the naked eye; and theſe motions continued a pretty while; but as ſoon as the moiſture of the muſcle, wherein the ſaid particle lay, was evaporated, the motions ceaſed; the exceeding ſmall particles, that lay round about, were put into ſuch motion, that one would have taken them for *Animalcula*.

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M. *Leewenhoeck* endeavoured for several years to discover the *Ovarium*, or egg-nest in muscles; and on the 18th of *November* having a present made him of exceeding fine, and well tasted muscles, some of which had laid their eggs in part upon their shells, and others had no eggs upon them; upon which he dissected several muscles again, and at length discovered the *Ovarium* of the muscle, and in a great many of them he could see the unborn muscles as perfect, as with the naked eye, lying with their sharp extremity fastened to the string, or vessels, by which they receive their nourishment; a few days after his above-mentioned discoveries, some muscles were brought him, that were lean, like some of the first muscles; and among them he observed about 25, that had not yet laid their eggs upon their shells, but most of them still shut up in the *Ovarium*, from which he took a great many eggs, which appeared even thro' the microscope so small, that he could but just discover their figure; in some other muscles the eggs were bigger; and whereas, the first unborn muscles, which he judged to be so perfect, as to be ready to be placed upon the shell, were of a brownish colour, mixed with little specks; so the exceeding small eggs were clear, and transparent; but in the larger eggs one might discover some of the parts of the little fish within: Moreover, he took out of the *Ovarium* of one of the muscles some particles, that were as big as an unborn muscle, and which were somewhat longer than broad, being very white, and some of them of a particular figure; so that he was surprised, and began to suspect, whether these might not be some of those creatures, which are so prejudicial to such as eat muscles: He afterwards was led to consider the excrement, or food of the muscle, as it lay in the guts; and he observed a gut, which had its beginning, or rather termination in the thinnest part of the fish (where the shell opens when the fish was in the water) and the said gut was near the extreme part of the fish, and run into that part where the stomach is: M. *Leewenhoeck* often separated this gut from the fish, and squeezing the matter out of it, he always observed that the earthy matter therein, was mixed with a great number of grains of sand of different magnitudes; insomuch, that he judged, that there was above a thousand grains of sand in one gut, some of which were as large as the sand on the sea-shore; but others again so small, that a thousand of them were not equal to one of the above-mentioned large grains: He extracted a second gut, out of the muscle that lay deeper

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in it, and therein he alſo diſcovered as great a quantity of ſand: He likewiſe ſqueezed the matter out of the guts of ſome muſcles, in which he found but few grains of ſand: Having examined the two above mentioned guts, he imagined, that one of them might be that, which conveyed the food to the ſtomach, and the other that which carried it off, after it was turned into chyle: He purſued his enquiry into the outermoſt gut, till he had brought it to the part he took for the ſtomach; and there he alſo diſcovered as many ſands in the matter that lay within it, as he had done before in the guts; and one might make greater diſcoveries in muſcles, were it not for the ſoftneſs and weakneſs of their parts. On the 20th of *January*, M. *Leewenhoeck* having diſſected ſome muſcles, diſcovered not only a great many ſands, but alſo ſeveral long, and very clear particles in their ſtomachs, the longeſt of which he judged to be about the diameter of a hair of one's head; others were not a fourth part ſo long; and he conjectured, by his naked eye, that their thickneſs was not the eighth part of their length, and they were as clear as cryſtal; ſo that he imagined them to be ſalt particles: He alſo obſerved ſeveral ſmall particles in the matter he took out of the ſtomach, which he concluded to be graſs, or ſomething like it; they conſiſted of very ſmall tubes, or pipes, which he ſuppoſed to be the ſmall parts of graſs; for, the tubes were much too ſmall for any ſtraw: In that matter he took out of the ſtomach, he likewiſe obſerved ſeveral very minute *Animalcula* ſwimming; and had not hitherto perceived the ſtomach ſo full of food, nor of ſo thin a ſubſtance as this was: He moreover obſerved, that in the ſeveral muſcles he opened, there were *Ovaria* or egg-neſts in them all; and he has taken the eggs out of them; and in thoſe he had opened latterly he obſerved, that the eggs were larger than any he had ſeen before; ſo that he concluded, that all muſcles brought forth young ones; and that the eggs, found on the outſide of the ſhell, were not all laid by the muſcle itſelf; but that other muſcles did alſo lay their eggs upon the ſhells of others; and accordingly he obſerved ſome ſhells that were covered all over with eggs: During the motion of the above-mentioned parts, which M. *Leewenhoeck* calls the beard of the muſcle, he obſerved ſeveral times two or three *Animalcula* ſwimming; and the ſmall particles, that lay round about, were put into ſuch a motion, that one would be apt to take them for *Animalcula* too; and he imagained after ſeveral obſervations, that if not all, yet at leaſt moſt of the ſhell-fiſh bring forth their young without copulation, and he believes it is the ſame in oiſters; and he was alſo of opinion,

that vaſt number of ſmall particles, which he diſcovered in them, and which he took for *Animalcula*, were nothing elſe, but the parts put into violent motion; but he owns as to oiſters, that theſe are rather conjectures than obſervations: M. *Leeuwenhoeck* affirms he never made ſo many obſervations, nor with ſo much pains, as he had done on muſcles; but not being able to ſatisfy himſelf, he wiſhes, that ſome one elſe would enter upon an enquiry about the production of ſhell-fiſh; for, as for his part he entirely gives it up.

An Account of what appeared on opening the Body of Mr. St. John, *aged* 72, *who died of an Aſthma; by Mr.* Cowper. Phil. Tranſ. N° 336. p. 534.

IT was remarkable before Mr. *St. John*'s body was removed from the bed, whereon it lay, - - - hours after his death, that the bliſter on the neck had diſcharged no leſs than a quart or three pints of *Serum* before Mr. *Cowper* began the diſſection: In the *Abdomen* there was a ſmall quantity of water, ſuch as is uſual in thoſe who die of chronical diſeaſes; the parts here were in a natural ſtate, excepting the kidneys, the right being very much contracted, even to a third part of its natural ſize, with two large *Hydatides*, or bladders of clear water on its ſurface; the left kidney was alſo contracted, but not ſo much as the right; its ſurface like that was unequal, but without any *Hydatides* thereon; the ureter of the left kidney was very much contorted, at its riſe from the *Pelvis*, where its ſides were petrified; inſomuch, that its canal was almoſt rendered impervious for the paſſage of the urine; nothing was found in the bladder of urine, but divers ſtones of unuſual figures, as if they had been pieces of a large ſtone broken to bits, in whoſe center a *Nucleus* had been lodged; the gall bladder was full of gall-ſtones; nor was the ſtomach which Mr. *St. John* complained of, *i. e.* for want of appetite, any other ways diſordered, than a little redder, and having more blood in its veſſels, than is uſual; its muſcular fibres were ſtronger than they generally are in healthful perſons: The cavity of the *Thorax*, or cheſt, was filled with water on both ſides; inſomuch, that the lungs were not above a third part of their natural ſize: The *Pleura*, or membrane, that lines the two cavities of the *Thorax*, was very much thickened by the *Serum*; from whence it deſcended by the muſcles of the back into his legs: The valves of the left ventricle of the heart, eſpecially thoſe called *Mitrales*, were petrified in ſeveral places: There were ſome ſtony concretions found on the *Bronchia*, at and near their riſe from the lungs.

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An Account of large Stones voided per Urethram; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 336. p. 536.

ONE *Joſhua Sparrit* of *Quarry-hill*, near *Leeds*, having been for a long time miſerably afflicted with the ſtone, voided three ſtones, which ſeemed to be too large to paſs the *Penis*; and Mr. *Pollard*, a ſurgeon of *Leeds*, did by an inciſion make way for five more, as they came ſeverally near the glans, which the patient could not otherways diſcharge; whenever one of theſe large ſtones broke out, there was heard a crack within his body, as if the ſphincter or bladder itſelf, were rent: This patient being opened after death, there were found on the top of his bladder (which was contracted like a purſe) two prodigious large ſtones; eſpecially one that was upwards of five inches and a half one way, and four the other; it weighed two ounces, wanting three drachms; the other ſeemed lighter, and weighed but one drachm above an ounce; there were two very odd ſtones extracted out of the right kidney; the left was entirely degenerated into a kind of mucilage; and between the neck of the bladder, and the extremity of the *Penis* (which was mortified thereby) were lodged no leſs than half a dozen ſtones: There was little moiſture left in the bladder, the *Ureters* being broken off, and almoſt quite conſumed.

Experiments on the Aſcent of Water between two glaſs Planes; by Mr. Brook Taylor *and Mr.* Hauksbee. Phil. Tranſ. N° 336. p. 538.

MR. *Taylor* faſtened two pieces of glaſs together, as flat as he could procure them; ſo that they were inclined in an angle of about two degrees and a half; then he put them into water, with the contiguous edges perpendicular; the upper part of the water, by riſing between them, formed the hyperbola, repreſented Plate XIII. Fig. 1. He examined it as well as he could, and it ſeemed to approach very near to the common hyperbola; but his *Apparatus* was not nice enough to diſcover this accurately; the perpendicular aſymptote was exactly determined by the edge of the glaſs; but the horizontal one he could not ſo well diſcover.

Mr. *Hauksbee* took two glaſs planes, each ſomewhat more than 20 inches long, of the trueſt ſurfaces he could procure; theſe being held cloſe together at one extremity, the other was opened exactly to an angle of 20 minutes; in this manner they were put edgeways into a trough of tinged water, which immediately roſe

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between them as represented in Fig. 3. At another time the planes were opened to an angle of 40 minutes, and then the water appeared between them, as in Fig. 2. By these schemes the proportions of the force of attraction are in some measure evident to the eye; for, there may be seen at the several distances, how many lines (which are 12ths of inches) the water is elevated, and the prodigious increase of them near the touching or contiguous extremities: The tables are pretty accurate; for, after several trials, Mr. *Hauksbee* found the success much the same, according to the different angles.

A table according to the scheme of the planes open'd to an angle of 40 min. in. Fig. 2.

Distanc. in inch. and parts of inch. from the touching extremities.	Number of lines elevat. at the several distances
9	1
6	2
4 3/4	3
3	4 1/4
2 1/2	6
2	7 1/2
1 1/2	10
1 1/4	12
1	15
0 3/4	19
0 1/2	28
0 1/4	59

A table according to the scheme of the planes open'd to an angle of 20 min. in Fig. 3.

Distanc. in inch. and parts of inch. from the touching extremities.	Number of lines elevat. at the several distances
13	1
9	2
7	3
6	3 1/4
5	5
4	6 1/4
3	9
2 1/2	12
2	15 1/2
1 3/4	18
1 1/2	21 1/2
1 1/4	27 1/2
1	35
0 3/4	50
0 1/2	76

An Account of the several Strata *of Earth, Stone, Coal,* &c. *found in a Coal-pit, at the west End of* Dudley *in* Staffordshire; *by Mr.* Bellers; *together with a Table of the Specific Gravity of each* Stratum; *by Mr.* Francis Hauksbee. Phil. Trans. N° 336. p. 541.

1. A Yellowish clay, which lies immediately under the turf. 2. A blueish clay. 3. A blueish hard clay, which the miners call clunch; this is one of the certain signs of coal; and it has

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has in it mineral plants. 4. A blueiſh ſoft clay. 5. A fine grained grey-ſtone; it lies next the former, and is found only in ſome pits. 6. A clay almoſt like the firſt, only whiter. 7. A hard grey-rock, with ſomething like the impreſſions of vegetables, but none diſtinct. 8. A blue clunch, like N° 3. with mineral plants therein. 9. This ſtratum the ſame with N° 13. was not taken. 10. Coal called bench-coal. 11. Coal leſs black and ſhining than the former, called ſlipper-coal. 12. Coal more black and ſhining, called ſpin-coal. 13. A coal reſembling cannal-coal, called by the miners ſtone-coal; theſe *Strata* of coal have between each of them a bat, of about the thickneſs of a crown-piece. 14. A black ſubſtance, called the dun-row-bat. 15. A hard grey iron ore, called the dun-row-iron-ſtone. 16. A blueiſh bat, wherein lies the following iron ſtone, called the white-row. 17. A hard blackiſh iron ore, lying in ſmall nodules, with an intermediate white ſubſtance; and hence by the miners called the white-row-grains, or iron ſtone. 18. A hard grey iron ore, with ſome white ſpots therein, called the mid-row-grains. 19. A black fiſſile ſubſtance, called the gublin-bat. 20. A hard blackiſh iron ore with ſpots therein, called the gublin-iron-ſtone. 21. A bat in ſubſtance much reſembling that of N° 19. 22. A hard grey iron ore, called the cannoc, or cannot-iron-ſtone. 23. A bat ſomewhat harder than N° 21. 24. A dark, grey, hard iron ore, called the ruble-iron-ſtone. 25. The table-bat, next under the ruble iron-ſtone. 26. A coarſe ſort of coal, called the foot-coal. 27. A black, brittle, ſhining bat. 28. The heathen coal. 29. A ſubſtance like a coarſe coal, but by the miners called a bat, perhaps becauſe it does not burn well. 30. The bench-coal. 31. A bat under the laſt, and as low, (*viz.* 188½ feet) as they generally dig, tho' there is a coarſe coal under this: It is to be obſerved, that theſe ſubſtances which divide the *Strata* of coals, and iron ores from each other, are called bats by the miners; they are generally black, conſiſting of a matter peculiar to themſelves, and of a texture neareſt reſembling marle, tho' ſome of them are fiſſile, and others have a ſubſtance not unlike coal mixed with them.

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A Table of the Thickneſs of each Stratum, *and its Proportion to Water, or its ſpecific Gravity.*

Number of the Strata.	Thickneſs of each Stratum. feet	inch.	Proportion to water.		Or ſpecific gravity.
1	4	0	as 385 to	192	as 200 to 100
2	5	0	296	168	176
3	24	0	23	9	256
4	9	0	209	106	197
5	4	0	583	237	246
6	21	0	401	192	209
7	75	0	683	259	243
8	5	0	223	88	253
9	1	0	—	—	—
10	3	0	7	5	140
11	3	0	106	72	147
12	4	0	147	114	129
13	4	0	185	143	130
14	1	0	408	198	206
15	0	1	204	67	303
16	0	3	183	72	254
17	1	3	325	232	334
18	0	2	781	244	320
19	2	0	305	129	236
20	0	9	920	266	346
21	1	6	192	76	253
22	0	6	675	216½	313
23	1	0	428	165	290
24	0	6	828	231	358
25	2	0	333	153	218
26	1	0	198	154	128
27	6	0	238	141	169
28	6	0	298	236½	126
29	0	1	267	186	144
30	2	0	314	240	131
31	0	6	244	133	182

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By this table it is evident, that the gravity of the several *Strata* is in no manner of order; but purely casual, as if mixed by chance.

An Account of the Eruption of Mount Vesuvius, *in* 1707; *by* S. Valetta. Phil. Trans. N° 337. p. 22. *Translated from the* Latin.

THE eruptions of this mountain are so frequent and continual, that they are almost innumerable; so that there does not pass a month, much less a year, wherein it does not break out with more or less violence and do more or less damage: The greatest eruption that had happened for some time, was that in 1707, when in the height of summer, in the latter end of *July*, mount *Vesuvius*, that had been quiet for some time, began to shew some signs of an eruption; for, at first those internal bellowings were heard, which resounded in the very centre of the mountain, yet without any smoke or flame; then by degrees it began to emit smoke and clear fire, which, especially in the night-time illuminated all *Campania*; in the mean time, at different intervals it made such a terrible noise, that the reports of our largest guns are scarce to be compared therewith; then it began to roll its ashes for several days and nights, conveying them aloft every way into the air, and dispersing them into different quarters according as the wind happened to blow; sometimes into the sea, at other times upon the adjacent territories of *Stabia*, *Nola*, and *Acerræ*; and what was very remarkable was a prodigious shower of stones, that destroyed both men and cattle; after this it began to belch out at its gaping mouth, a liquid torrent of bitumen, called *Glareæ*, or grit; which at first appeared like a gentle stream of fire, descending with the same slowness of motion, as is observable in melted pitch, or the like viscid substances; this matter, which resembled molten glass, as it cooled in its progress, became as hard as stone: It was observable, that the superior surface of this matter, as it cooled, was converted into small spongy stones, but its lower surface into a broad, hard, solid, flint, (long used in paving the highways) as if what lay next the air had admitted and retained some of its particles, whilst its lower part became a solid compact mass without any vacuities: Moreover, among a great many phænomena of this vulcano, there were two that had not been observed for several ages before; for, about the third or fourth day it began to emit at its mouth flashes of lightning, almost like those, sometimes observed in the air, but of a serpentine form; and withal very loud claps of thunder

thunder were heard, ſo thick and frequent, that at firſt it was thought it would rain, 'till it was perceived they proceeded from the mountain, and that the dark clouds did not conſiſt of vapours, but of large quantities of aſhes; in the mean time on the ſecond of *Auguſt*, at four in the afternoon, there was ſuch a thick cloud of aſhes hovering over *Naples*, as intercepted the rays of the ſun; and the darkneſs was ſo great, that people could not diſtinguiſh in the very ſtreets their neighbours and friends; in a word, no mid-night darkneſs exceeded it; if any adventured abroad with torches, they were obliged to return home again; which only happened once before in the emperor *Titus*'s time, according to *Xiphilin*: So that every place was filled with the ſhrieks of women, but the more prudent betook themſelves to prayer to Almighty God, and with apprehenſions expected the event of ſuch a prodigy: Both the magiſtracy and clergy appointed ſupplications to be made, and to carry in proceſſion to the *Capuan* gate, which regards the mountain, the relicks of St. *Januarius*, the tutelar ſaint of this city; whither when they were come amidſt the palpable darkneſs of the day, at laſt about the firſt or ſecond hour of the night, towards the north, where perhaps there was not ſo large a quantity of aſhes, a ſtar or two were ſeen, and the azure face of the heavens began to appear, and afterwards the darkneſs that had obſcured the day, gradually to diminiſh in the night; and the aſhes, by the ſhifting of the wind, to be driven into the ſea; the following day continued ſomewhat dark, by reaſon of the remains of the aſhes interſperſed in the air: *Veſuvius*, having thus covered the fields with aſhes, and belched out its grit for ſeveral days, ſo that its black torrent, had almoſt reached the neighbouring ſea, at length in about 15 days it was ſeen to ceaſe: Upon this the *Neapolitans*, to perpetuate the memory of *Januarius*, whom they always found propitious to them in their calamities, ſtruck a medal of gold and ſilver, with St. *Januarius*'s head on one ſide, and this legend.

DIVO JANUARIO LIBERATORI URBIS FUNDATORI QUIETIS.

And on the reverſe mount *Veſuvius* with this inſcription.

POSTQUAM COLLAPSI CINERES ET FLAMMA QUIEVIT CIVES. NEAP. INCOLUMES. A. MDCCVII.

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An Account of the Roman *Legions; by Dr.* Muſgrave. Phil. Tranſ. N° 337. p. 80. *Tranſlated from the* Latin.

BOTH the inſtitution, and name *Legio*, are *Roman*, deriv'd from *legere*, to chuſe or levy ſoldiers, *Varro de Ling. Lat.* lib. 4. The ſtate and condition of the *Roman* legions before *Auguſtus*'s time, was quite different from what it was afterwards; whether we regard the number of the legions, or the number of ſoldiers in each legion: Sometimes they took their names from ſuch as either levied or commanded them; as thoſe levied by *Valerius Flaccus*, were called from him *Valerianæ*, Salluſt. *Frag.* & *ad ea* Douzæ *Not. Cantabrig.* 1710. p. 73. But *Fimbria* having afterwards the command of them, they were from him called *Fimbrianæ*, ibid. p. 74. The number of ſoldiers in a legion, during the the *Roman* republic, is uncertain, ſometimes more and ſometimes leſs; but which for the moſt part, was gradually increaſed, yet ſo as to be generally leſs, than under the emperors; the firſt legion of *Romulus*, conſiſted, according to *Varro de Ling. Lat.* lib. 4. of 3000 foot; *Plutarch in Romulo*, adds to theſe 300 horſe; afterwards, according to the exigency of the republic, and at the will of the ſenate the number was encreaſed to 4000. *Liv.* lib. 4. c. 22. to 4500 ibid. Lib. 7. c. 25. to 5200. Lib. 42. c. 31. vid. *Perizonii notam ad loc.* and to 6000 foot, and 300 horſe: And this which is carefully to be obſerved, appears to have been done, not according to the uſual manner and common cuſtom of the *Romans*, or by any ſtated law, but either in ſome imminent danger, as in the *Punic*, *Liv.* lib. 29. c. 25. *Macedonic*, lib. 42. c. 31. and *Mithridatic* wars, *Appian. de bell. civil.* lib. 4. or by the authority of the general, as of *Marius* in the *Jugurthin* war, *Salluſt. bell. Jugurth.* §. 91. *Roſin. Antiquit. Rom.* lib. 10. c. 4. Of *Antony* in the civil war, *Appian. Alex. de bellis civil.* lib. 5. and not by any decree of the ſenate. Some paſſages in *Plutarch* and *Eutropius*, are ſuppoſed to contradict what is here alledged of the number of ſoldiers in a legion, under the kings, and in the infancy of the republick; *Plutarch* writes thus, Διπλασιαθεισης δε της πολεως, δικαιον μεν ἐκ Σαβινων παλρικιους προσκαθελεχθησαν, αἱ δε Λεγεωνες ἐγενοντο, πεζων μεν ἑξακισχιλιοι, ἱππεων δε ἑξακοσιοι; that is, 'the city becoming twice as numerous as at firſt, upon enfranchiſing the *Sabines*, there were choſen 100 patricians more, from 'amongſt the latter, and the legions came to conſiſt of 6000 foot 'and 600 horſe; which paſſage as it ſeems to cauſe the difficulty to *Sigonius*, *Savilius*, *Roſinus*, *Panvinius* and *Sigonius*,

may be very well explained out of *Dionyſius* of *Halicarnaſſus*, lib. 2. § 16. in the following manner; *Romulus* had (after the diſpute with his brother *Remus*) about 3000 foot, and not quite 300 horſe of the old colony, that aſſiſted him in founding *Rome*; but when the city became twice as numerous, and the number of patricians was encreaſed in like manner, the militia or legions were alſo doubled; ſo that *Plutarch* ſhould ſeem to mean not ſo much the augmenting the number of ſoldiers in one and the ſame legion, as augmenting the number of legions themſelves, in like manner as the number of citizens and patricians had been augmented; it is very certain (nay even according to *Plutarch* himſelf in *Romulo*) that the legion, ſaid above to be inſtituted by *Romulus*, conſiſted of 3000 foot and 300 horſe; only our hiſtorian, not very accurate in military affairs, ſeems to have miſtaken one thing, when he calls *Romulus*'s firſt legion Συνταγματα σπειρων in the plural number, ſince *Varro* the moſt diligent enquirer into antiquity, ſays, in his book *De Lingua Latina*, lib. 4. that at firſt a legion conſiſted of 3000 men; a thouſand from each of the three tribes, viz. the *Tatienſes*, *Ramnenſes*, and *Luceres*; and this interpretation *Lipſius* adopts in his book *De Militiâ Rom.* lib. 1. dial. 5.

The paſſage in *Eutropius*, lib. 2. § 6. is as follows; 'when 'the *Latins*, who were ſubdued by the *Romans*, would not be 'enrolled, the latter levied raw young men from among them-'ſelves, and thus 10 legions were compleated, which amounted 'to upwards of 60000 men;' but this ſeems to be a blunder of the tranſcriber's, it being probable that *Eutropius* might have written XL *vel amplius armatorum millia*, which agrees exactly with *Livy*'s account, lib. 7. c. 25. and that the tranſcriber, by tranſpoſing the numeral letters, might make LX inſtead of XL, which might be very eaſily done.

Another argument in oppoſition to the paucity of men in a legion in the early times of the republic, is taken from the ſignification of the word *Centuria*; Varro *in loco citat.* ſays, 'that 'a *Centuria*, which is under the command of one centurion, 'conſiſts of 100 men compleat;' and on the authority of this etymology, ſome of the learneſt men maintain, that a legion conſiſted of ſix thouſand, ſince a legion has 60 centurions, as the law preſcribes, according to *Dionyſius* of *Halicarnaſſus*. *Antiq. Rom.* lib. 9. c. 10. and *Cincius* in *A. Gellius*, *Noct. Attic.* lib. 16. c. 4. and accordingly by ſome, *Legio*, is *Sexaginta centuriarum ſeu ſex millium*: But we may obſerve that it is no

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new thing for words to deviate very much from their original ſignification; for it is plain from *Tacitus Annal.* lib. 1. c. 38. that the term *Centuria*, tho' at firſt taken to denote 100, yet in proceſs of time, came to expreſs a much ſmaller number: The ſoldiers in the ſedition in *Germany*, in the reign of *Tiberius*, in order to avenge themſelves of the cruelty of their centurions, fell upon them, and 60 men to each centurion, to equal their number, laid them proſtrate and beat them; here it is plain, that a centurion had the command of 60 men only.

Towards the latter end of the republic, each of the leading men acted herein almoſt at his own diſcretion; *Lucullus*'s legions, according to *Appian. de bellis Mithridat.* p. 368. contained 6000 foot and 300 horſe each; *Cæſar*'s legions conſiſted of 3600; ſo *Sextus Rufus* in *Breviario*; *Antony*'s legions according to *Appian. de bellis civil.* lib. 5. p. 1075. edit. *Amſt.* 1670. after the battle at *Philippi*, including the auxiliaries, conſiſted each of 6000 men, and conſequently of 3000 without the auxiliaries; and the Dr. ſuſpects the ſame to hold of *Lucullus*'s legions, *viz.* that the auxiliaries are included; and that conſidered by themſelves, they amount only to 3000.

The *Legio* was different under the *Cæſar*'s, as in moſt other things, ſo eſpecially in the number of men; which for the moſt part, by order of the emperors, became 6000, and ſometimes upwards; and this is plain from *Vegetius*, *De re militari* lib. 2. c. 2. who ſpeaks of this matter to the following purpoſe; 'The *Romans* had legions each of which were wont to conſiſt 'of 6000 men, and ſometimes upwards; and c. 6. a compleat 'legion conſiſts of 6100 foot, and 726 horſe:' And *Vegetius* is not to be ſuppoſed to have writ this of the age wherein he liv'd himſelf, but of that in which thoſe authors lived, from whom he drew his epitome of military affairs, among whom is *Cornelius Celſus*, mentioned by *Volaterranus*, lib. 14. 'Cornelius 'Celſus, ſays he, writ treatiſes of rhetoric, military affairs, 'husbandry and phyſic; but this latter only, written in a rhetorical ſtyle, has been handed down to us;' *Vegetius* affirms, that he had peruſed *Auguſtus*'s conſtitutions of military affairs, (one of which was preſerved by *Macrus* the lawyer, in his pandects, digeſt. lib. 49. tit. 16.) and lib. 2. c. 8. he profeſſes to deliver nothing upon his own authority, but on that of *Cato*, *Celſus*, *Frontinus*, and the conſtitutions of *Auguſtus*, *Trajan* and *Adrian*: Wherefore it ſeems probable, that either under *Auguſtus* or *Tiberius* (in whoſe reign *Celſus* writ) the number of men in a legion was augmented to 6000, and never after that conſiſted

of fewer; which is manifeſt partly from *Frontinus*, and partly from more modern authors, *viz. Modeſtus*, *Heſychius*, and *Suidas*. Modeſtus, Lugd. Batav. ex officin. Plantin. 1592. p. 291. affirms, *that a legion, conſiſting of* 10 *Cohorts, is compleat, containing* 6505 *foot, and* 726 *horſe*; this author flouriſhed in the emperor *Tacitus*'s time, to whom he dedicated a book of military terms. *Heſychius in voce* Λεγεων, ſays, Λεγεων, πληθος στρατευμαϛος ἢ ταγμαϛος ἐξ χιλιαδων ἑξακοσιων ἑξηκονϛα ἑξ, *i. e.* a legion contained 6666 men. *Suidas ibid.* Λεγεων παρα Ρωμαιοις ἑξακισχιλιοι στρατιωται, *i. e.* a *Roman* legion conſiſted of 6000 men; ſo that it is plain, that from *Auguſtus*, the founder of the *Roman* empire, down to its period, a legion contained 6000 men, and ſometimes upwards.

As to the number of legions; it is manifeſt, that it was different at different times, and it neceſſarily muſt have been ſo, according to different emergencies: *Romulus*, as was ſaid, had at firſt but one legion; afterwards, the city becoming twice as numerous, the number of legions was in like manner doubled; and tho' the number of *Roman* ſoldiers, as in *Dion. Halicarn. Antiq. Rom.* lib. 2. c. 16. were augmented under *Romulus*, to 40000 and upwards; and tho' *Tullus Hoſtilius* be ſaid by *Florus* lib. 1. c. 3. 'to have inſtituted the whole military diſcipline and art of 'war;' yet we no where find that the number of the legions under the kings, exceeded two: 'All authors agree *ſays Vegetius*, 'lib. 2. c. 4. that each conſul led no more than two legions, including the auxiliaries of the allies, againſt the moſt numerous 'enemy; ſuch was their military experience, and ſuch their 'courage, that two legions were reckoned ſufficient in any war;' but nothing can be wider of the truth than this; for on the contrary *Dionyſius* of *Halicarnaſſus*, a very grave author, in the war againſt the *Volſci*, ſays, *Antiq. Rom. lib. 6. c. 42.* ἡ γαρ δεκα στρατιωτικα ταγμαϛα ἐξ ἀνδρων τετρακισχιλιων ἐκαλουν. Τουτων τρια μεν ἐκαϛῳ των ὑπατων ἐλαβεν, και των ἱππεων ὁσον ἐκαϛῳ προσεμεριϛη. *i. e.* 'there were 10 legions levied, containing '4100 men each; of theſe the two conſuls had three legions 'aſſigned them, and as many horſe as fell to their ſhare.' *Livy lib.* 2. *c.* 30. ſpeaking of the ſame war, affirms, 'that there 'were 10 legions completed, three of which were given each 'conſul, and the dictator had four;' and that there were often a greater number of legions is very evident, two of which only were under the command of the conſuls, and the reſt under that of the pro-conſuls, prætors, proprætors, the *Præſides* and *Pegati*; 'Q. *Fabius* and M. *Marcellus* being conſuls, the former

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'the fourth time and the latter the third, about 538 U. C. the 'war was carried on with 18 legions *Liv. lib.* 24. *c.* 11. in the 'conſulſhip of *Fulvius* and *Sulpitius*, *i. e.* about 541. U. C. 'the war was carried on both by ſea, and land with 23 *Roman* 'legions, *lib.* 26. *c.* 1.' Before the battle at *Pharſalia*, *Cæſar* commanded ten, and *Pompey* eleven legions, beſides a great number of auxiliaries, *Appian. de Bellis civil. lib.* 2. When *Caſſius* and *Brutus* were to engage *Antony* and *Octavius Cæſar*, there were 19 legions on each ſide, in all 28, *lib.* 4. after the defeat of *Lepidus*, *Octavius Cæſar* had 44 legions, *Plutarch. in Anton.* and beſides, after the battle at *Actium* *Antony*'s 19. legions ſubmitted to him, *ibid.* After *Octavius* had made himſelf entire maſter of the *Roman* empire (the army being new modelled, and the number of men in each legion augmented to 6000) there were 23 legions *Dion. lib.* 55. or according to others, 25. There were 25 legions under the emperor *Tiberius*, *Tacit. Annal. lib.* 4. and according to the ſame author, *Nero* had the ſame number, beſides two other legions for the navy, and 12 *Cohorts* at *Rome*: Therefore according to *Lipſius*'s computation, *Analect. ad. Militiam Roman.* his forces, conſiſting of *Roman* citizens, amounted to about 30 legions; it is evident from the celebrated ſaying of *Favorinus*, that *Adrian* had the ſame number. In *Dio Cocceianus*'s time, *i. e.* under the emperor *Alexander Severus*, the number of legions was 29, *Dio. lib.* 55.

The following table exhibits the number and names of the legions inſcribed on the *Columna rotunda* in the *Capitol* at *Rome*.

II. AVGuſta	I. ADJVTrix	IIII. SCYTHica
VI. VICTrix	IIII. FLAViana	XVI. FLAViana
XX. VICTrix	VII. CLAVDiana	VI. FERRAta
VIII. AVGuſta	I. ITALICa	X. FRETEnſis
XXII. PRIMigenia	V. MACEDonica	III. CYRENaica
I. MINERvia	XI. CLAVDiana	II. TRAJana
XXX. VLPiana	XIIII. GEMina	III. AVGuſta
I. ADJVTrix	XII. FVLMinatrix	VII. GEMina
XIII. GEMina	III. GALLICana	III. ITALICa
I. PARTHica	II. PARTHica	III. PARTHica

The

The following catalogue with the *Maffei* at *Rome* contains three legions more than the preceeding.

II. AVGuſta	II. ADJVTrix	IIII. SCYTHica
VI. VICTRix	IIII. FLAVIana	XVI. FLAVIana
XX. VICTRix	VII. CLAVDiana	VI. FERRAta
VIII. AVGuſta	I. ITALICa	X. FRETEnſis
XXII. PRIMigenia	V. MACEDonica	III. CYRENaica
I. MINERvia	XI. CLAVDiana	II. TRAJana
XXX. VLPiana	XIII. GEMina	III. AVGuſta
I. ADJVTrix	XII. FVLMinatrix	VII. GEMina
X. GEMina	XV. APOLlinaris	II. ITALICa
XIIII. GEMina	III. GALLICana	III. ITALICa
I. PARTHICa	II. PARTHICa	III. PARTHICa

That theſe inſcriptions are later than *Dio*'s time, is evident from this, that both contain a greater number of legions than he mentions; as the capitoline inſcription, one legion, and the *Maffean*, four more.

From what has been ſaid we may obſerve 1. That the number of legions under the *Roman* conſuls at one and the ſame time was greater than under the emperors, and feweſt of all under the kings. 2. That under the conſuls, their number was greater in civil than foreign wars. 3. That their number is leſs certain, under the conſuls, than under the kings or emperors. 4. That the ſtated number of legions, according to *Lipſius*, was about thirty. 5. That none ever had a greater number of legions, than *Octavius Ceſar*, as none ever had a more flouriſhing army, according to *Lipſius in Analect. ad Milit. Roman.* than *Trajan*. 6. And laſtly, that a true judgment cannot be formed of the ſtrength of their armies, from one and the ſame number of legions.

Here the two following rules may be laid down, which will be of conſiderable uſe for underſtanding the *Roman Hiſtory*, eſpecially their military affairs; the firſt, that where the number of ſoldiers in an army is expreſſed, without that of the legions (which is commonly *Appian*'s way) in order to reduce the army into legions, you muſt obſerve in what age it was, and what was the uſual number of men in a legion of that age; for that number dividing the number of men in the whole army, the quotient will be the number of legions therein; *e. g. Lucullus*'s army againſt *Mithridates* was, according to *Appian de Bellis Mithridat.* 30,000 foot and 1600 horſe, *i. e.* (ſuppoſing 6200 in each legion, which was the number of men, including auxiliaries,

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arics, in a legion of that age) five legions; according to *Tacitus Annal. lib.* 4. an army of 30,000 men was cut to pieces by *Boadicea*, *i. e.* (supposing that each legion according to the custom of that age, consisted of 12,000 men) about six legions.

Rule 2d, Given the number of men in a legion of any age, together with the number of legions in an army of the same age, you will hence have the number of men in that army; and hence it appears, that *Romulus*'s army, consisting at first but of one legion, did not exceed 3000, or according to *Plutarch* 3300 men; afterwards upon the admission of the *Sabines* into *Rome*, and the addition of another legion upon this increase of the city, 6000, or 6600; nor indeed a greater number, tho' (as was said above from *Dionysius*) after *Romulus*'s death, there were 45,000 soldiers in *Rome*: In the war against the *Volsci*, *Æqui* and *Sabines*, there being 10 legions, and in each legion 4000 men, the whole must necessarily amount to 40,000. Under the *Roman* emperors, when there were almost 30 legions, the whole number, when compleat, amounted to (multiplying 6500 by 30) 195,000, or 200,000 men more or less; and adding the allies, of whom there was an equal number, to 400,000.

The Culture of Canary Seed; *by Mr.* Edward Tenison. Phil. Transf. N° 337. p. 91.

TO prepare land for this seed, let it be broke up some time in *April*, and ploughed again about *Midsummer*, and again in *August*, that by frequent tillage the weeds may be burnt up and destroyed; plough it for the last time about the latter end of *February*, or the beginning of *March*, if the season prove dry; if not, you had best wait for a dry season, for then only will the ground be fit to receive the seed; you must from time to time carefully cut up the weeds with a hoe, having a bit about the bigness of an onion hoe; and if they are not kept entirely under, a deal of the seed will be lost for want of ripening; in very good land half a bushel of seed will be sufficient to sow an acre; it will thrive best upon a stiff clay; it will grow upon any sort of loamy land, that is rich enough to bear hemp; if you apprehend, that the land is not sufficiently strong, you will do well to allow from half a bushel to seven gallons of seed to sow an acre with: The seed is ripe sooner or later, according as the spring affords you an early, or late season for sowing it; in some summers it is cut in *August*, but the most usual time is after wheat-harvest; when cut down, for most years it must lie five or six days in swarth, and afterwards be turned,

and

and lie, till one side is dried, and rotted as much as the other; which may be in about four or five days longer; the certain number of days cannot be fixed, being more or less, according as the weather proves fair, or rainy; the reason of its lying so long in swarth is, that the lower heads of the seed (being exposed to the air, wind, and sun) may be throughly ripened, and the grass, and weeds that spring up with the stalks throughly withered, and the ears, or heads well and sufficiently rotted, that the seed, upon threshing, may come out clean: The produce on land that is very good, is about six quarters *per* acre; if the land be but indifferent, or if the weeds be not kept under, then from four to five quarters upon an acre is as much as can be expected; the price of seed is from two to six pounds *per* quarter; but the most usual price is from 40 *s.* to 3 *l.* It is hard to thresh; so much of the seed, as after threshing, is beaten out (as soon as fanned) is to be run thro' a wire sieve, such as is used to separate cockle from corn, and the husks of every sifting, that will not pass thro' the sieve, are to be thrown by in a heap to be threshed over again: The ordinary price for threshing is 5 *s.* but in some years the thresher has 6 *s. per* quarter.

Observations in Natural History *and* Antiquities *in* Wales *and* Scotland, *from* 1696 *to* 1699; *by Mr.* Lhwyd. Phil. Trans. N° 337. p. 93.

MR. *Lhwyd* found abundance of the *Bistorta*, and *Nasturtium petræum* of *Johnson*, and a new plant in the small lake of *Phynnon Urêch*, where the *Subularia* grows; he met with several rare plants in other places, as *Echium marinum* J. B. *Asparagus sylvestris*; *Eruca marina*; *Eruca sylvestris laciniata lutea*; *dulcamara marina*; *tithymalis marit.* *Beta marina*, &c. in *Caernarvonshire*, and *Anglesey*; and in *Meirionydshire* he found abundance of the *Snowdon* plants at *Kader Idris*, and *Balsamina lutea* in the high road, near a place called *Capel Begla*; in south *Wales* he found several plants very common, which he had never observed in north *Wales*; as *Eruca sylvestris*, common on the walls of their towns and castles; *Asplenium S. Geterach. Offrin. Centaureum luteum perfoliatum*; *Linum Sylvestre*, *fagus*, &c. in *Pembrokeshire* he met with two plants, which he suspected for new, *viz.* a *Tripolium*, and an *Anthyllis leguminosa supina, flore coccineo*: Amongst several others he found a large crystal, above *Phynnon Urech* about seven inches long, and as thick as his wrist; in *Monmouthshire* he met with large petrified *Pectines*, and some few formed stones in each county.

In

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In the coal-pits of the forest of *Dean*, he found all the species of capillaries, besides some other new plants, and two species of *Astropodium*, gathered on the *Severn* shoar, the only rarities of the kind, he supposes to have been discovered; Mr. *Lhwyd* doubts not, but that the coal plants have been observed by the workmen long since, tho' they escaped the notice of naturalists; and he found it well known to all his country colliers, by the name of *Carreg Redynog*, i. e. the ferny stone; and one Mr. *Williams*, arch-deacon of *Cardigan*, told Mr. *Lhwyd* he had observed much finer patterns 25 years before in the coal-pits of *Glamorganshire*; we often met with the stalks of fern, and harts-tongue, but did not observe any of the roots; and Mr. *Lhwyd* could not well tell, whether the impressions of the stalks could be easily distinguished from those of the roots; we also often met with the membranaceous substance of leaves.

Plate XIII. Fig. 4. represents *Astropodium furcatum, sive stellæ marinæ Magellanicæ radii lapidei.*

Fig. 5. *Astropodium ramulosum, sive stellæ arborescentis virgultum lapideum.*

Fig. 6. *Hexapetalon carbonarium.*

Fig. 7. *Radiatula*, &c. *An flos cujusdam Chrysanthemi?*

Fig. 8. *Phyllitis trifolia.*

Fig. 9. *Abietis, an potius Lycopodii cujusdam ramulus?*

Mr. *Lhwyd* could never see any of the coins of the princes of *Wales*; tho' the bishop of *Bangor*, who was very well skilled in *British* antiquities, told him a relation of his had one of *Lhywelyn ab Iorwerth*, cotemporary with *Richard* I. and king *John*; by the princes of *Wales*, Mr. *Lhwyd* means the *British* princes from K. *Kadwaladr*, about the year 600, to the last prince *Lhewelyn ap Gruffydth*, about the year 1280; he found several of the more ancient *British* coins, of which there are divers figures in *Camden*; Mr. *Nicholson* quotes *Cæsar*'s authority for the *Britons* having no coins; whereas on the contrary, *Cæsar*'s words are *Numma utuntur parvo & æneo*; nor can Mr. *Lhwyd* see any reason to doubt of *British* coins of all sorts of metal, till it can be shewn whose coins those are, which Mr. *Camden* and other authors take to be *British*: the druid beads are generally glass; since the last edition of *Camden*, Mr. *Lhwyd* met with two or three of them, with a snake plainly painted round them; so that he takes it for granted, that the *Ova anguina* of the *British* druids were these glass beads, tho' those of the *Gaulish* druids were the shells of the *Echini orbiculati laticlavii.*

We searched the high mountain by *Brecnock*, called *Tvann uwch deni*, but found nothing new therein, nor any great va-

riety of rare plants; the choiceſt were *Sedum Alpinum ericoides* in great abundance; *Argemone lutea*, *Rhodia radix*, *muſcus cupreſſiformis*, and about half a dozen more of the common *Snowdon* plants; *Lyſimachia chamænerion dicta*, is a common plant (called by the name of *Lhyſie'r Milwr*, i.e. *herba militaris*) in the meadows thro' all the upper parts of *Brecnockſhire*; we alſo met with *Sorbus legitima*, and *Sorbus torminalis*, grown to as great a height as the *Ornus*, neither of which had ever occurred before in *Wales*; but of all theſe topical plants he was ſurpriſed at none ſo much as the *Capillus veneris verus*, growing very plentifully out of a marly incruſtation, both at *Barry* iſland, and *Porth Kirig* in *Glamorganſhire*, and out of no other matter; and alſo that *Gnaphalium majus Americanum* ſhould grow on the banks of *Rymny* river, which runs altogether over iron-ſtone, for the ſpace of at leaſt 12 miles, beginning near the fountain head in a mountain of this county, and yet not a plant of it to be ſeen elſewhere throughout *Wales*: In a large lake called *Lhyn Savadhan* he found a pellucid plant, he had never met with before; the leaves were exceeding thin, and tranſparent, in ſhape not unlike ſmall dock-leaves, but the middle rib was continued beyond the extremity, ſo that each leaf had a ſoft prickle at the end; we likewiſe found there the *Hippuris ſauva*, and two elegant ſorts of ſmall leeches, which Mr. *Lhwyd* ſuppoſes not deſcribed: The lime-ſtone of this county affords ſmall *Gloſſopetræ* and *Siliquaſtra*, yet but very ſcarce in compariſon of the quantity found in *Oxfordſhire*, *Northamptonſhire*, *Berks*, &c. The moſt conſiderable rarities it affords are fairy cauſways, which Mr. *Lhwyd* calls ſo in imitation of the giant's cauſway in *Ireland*; for, whereas the latter may be half a mile long, the former ſeldom exceed three foot; our lime quarries yield two or three bodies congenerous with it, tho' of a very different form, and perhaps may all be referred to the coralline claſs, the ſecond in Mr. *Lhwyd*'s catalogue.

Fig. 10. repreſents a green adder's head, adorned with the ſkeletons of ſnakes of a citrine colour.

Fig. 11. a black adder's head, adorn'd with nine ſmall ſnakes, or *Cornua Ammonis* of a whitiſh blue.

Fig, 12. an adders head, reſembling cherry-tree-gum, adorn'd with a ſnake, chequer'd blue and white.

END of the FIFTH VOLUME.

THE

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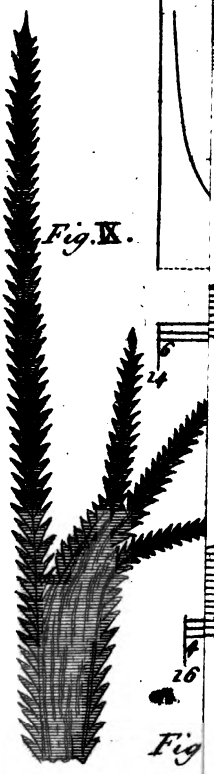

Fig. IX.

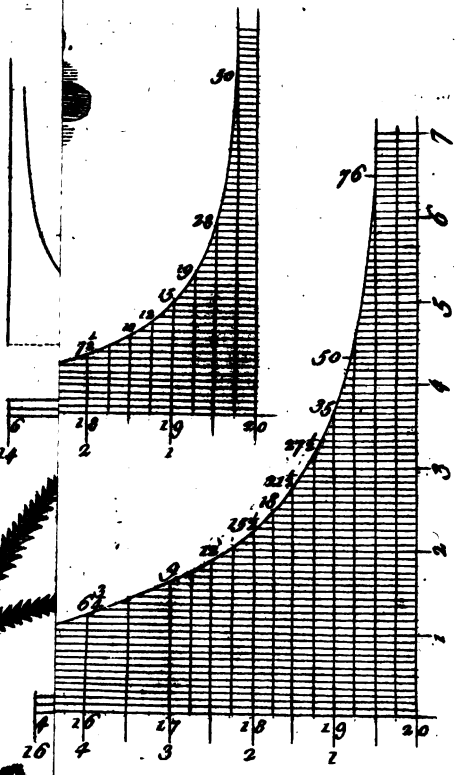

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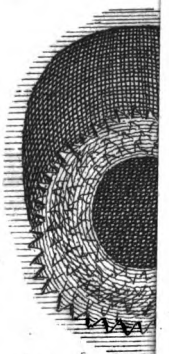
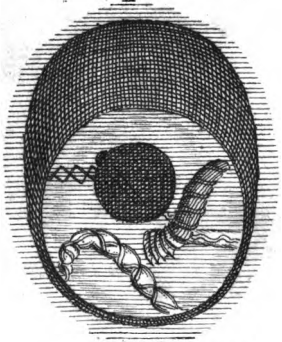
Fig. XII.





G. Smith del.

Hulett Sculp

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CORRIGENDA.

PAGE 6. line last but 12. for Sangues *r.* Sanguis. *P.* 12 *l.* 14. for foranen *r.* foramen. *P.* 14. *l.* 38. for its *r.* their. *P.* 15. *l.* 25. for renales *r.* renalis. *P.* 16. *l.* 3. for muliebris *r.* muliebres. *P.* 27. *l.* 22. for Milliary *r.* Miliary. *P.* 28. *l.* 7. for horer *r.* border. P. 40. *l.* 8. after in the, *r.* same. *P.* 54. for *a* BD *r.* A BD. ibid. *l.* 19. for B D *gf r.* B D F B. *P.* 57. *l.* 34. for Salleys *r.* Sallows. *P.* 82. first column to the left hand *l.* 3. for Horn church *r.* Horn-church Church. *P.* 83. *l.* 11. after as *r.* to. *P.* 128. *l.* last but 9. for itself *r.* himself. *P.* 171. *l.* 16. for acaustic *r.* acoustic. ibid. for cataucaustic *r.* catacoustic. ibid. *l.* 17. for diacaustic *r.* diacoustic. ibid. *l.* 21. for acaustics *r.* acoustics. ibid. *l.* 35. for Plate V. *r.* Plate IV. ibid. *l.* last but 4. for would *r.* it would. *P.* 172. *l.* 19. for P M *r.* F M. ibid. *l.* 31. for acaustic *r.* acoustic. ibid. *l.* 3. for acaustic *r.* acoustic. *P.* 174. *l.* 3. in C *n* N O G dele O. *P.* 175. *l.* 19. after O S put a semicolon. ibid. *l.* 20. after the point G dele the semicolon; ibid. *l.* 24. after A L put a comma. ibid. *l.* 26. for bonominated *r.* denominated. ibid. *l.* 29. for *yr r.* Y^r ibid. for $\frac{1}{x}$ *t r.* $\frac{1}{x}$, ibid. *l.* 31. for the Multiplicate *r.* Multiplica e. *P.* 178. *l.* last but 7. for S gn *r.* Sine. ibid. *l.* last but 4. *r.* Let the axis of the curve N *n* G, which the refracted ray describes, be CO; *P.* 179. *l.* 19. *r.* $y = \frac{1}{x}$ *P.* 217. *l.* 18. for *sinu r. sin. P.* 251. *l.* ult. but 6. for that *r.* since. *P.* 253. *l.* 34. for vagitis. *r.* vagitus. *P.* 382. *l.* 30. for $M^n - 1$ F. *r.* $M^n - 1$ F ibid. for $M^n - 2$ F^2 *r.* $M^n - 2$ F^2 ibid. *l.* 31. for $M^n - 3$ F^3 *r.* $M^n - 3$ F^3 *P.* 384. *l.* 10. for $\frac{1}{2}$] ^{82} *r.* $\frac{1}{2}$] ^{84} *P.* 401. *l.* 26. or returned *r.* received.

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